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The Concept of Supply Chain Agility: Conceptualization, Antecedents, and the Impact on Firm Performance

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The Concept of Supply Chain Agility: Conceptualization, Antecedents, and the Impact on Firm Performance

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ABSTRACT

Agility has been identified as one of the most salient issues of contemporary supply chain management. Despite its importance, there has been limited theory development in the firm supply chain agility area. Elements and linkages among agility elements are underdeveloped, and it is uncommon for any two authors to adopt the same definition. A rigorously validated survey instrument is also needed to enable researchers to credibly build on theories regarding causal links among agility-related capabilities, practices and performance outcomes. The sports science and military science theoretical bases are investigated to better understand agility and identify its dimensions, and define it in a supply chain context. Moreover, a comprehensive measurement instrument that draws on the foundations of social and life science theory is developed and empirically validated so that researchers can rigorously expand agility theory.

The antecedents of firm supply chain agility have been primarily addressed at an operational level. This dissertation expands on the work of Braunscheidel and Suresh (2009) who explored the role of different managerial orientations in achieving supply chain agility. Finally, scholars have issued research calls for an in-depth understanding of the performance outcomes of firm supply chain agility and accentuated the need to empirically examine such outcomes from an efficiency and effectiveness perspective. This dissertation responds to such calls, and also investigates the impact of firm supply chain agility on the firm's financial performance using secondary, Compustat data. Thus, this research further contributes to theory development by providing a better understanding of how firm supply chain agility impacts firm performance. Relevant managerial implications are also presented.

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CHAPTER 1-DEFINING THE RESEARCH

INTRODUCTION

The current business environment can be characterized by constant change, turbulent and volatile markets, shorter product life cycle, and increased demand uncertainty (Christopher 2000; Agarwal et al. 2007; Almahamid et al. 2010). As these conditions became the norm, business organizations and business researchers alike have turned to the concept of agility in their quest for a sustainable source of competitive advantage. Agility has been noted as a means for handling change, increasing customer responsiveness, and mastering market turbulence (Van Hoek et al. 2001; Ismail and Sharifi 2006). Furthermore, it has emerged as the dominant competitive vehicle for organizations in such an uncertain and ever-changing business environment, and has been heralded as the business paradigm of the 21st century (Tseng and Lin 2011).

The origins of agility as a business phenomenon can be traced to the manufacturing literature. Agility was popularized in 1991 by a group of scholars at the Iaccoca Institute of Lehigh University. Soon after its introduction, the concept became a focal reference for manufacturing systems studies (Nagel and Dove 1991; Hallgren and Olhager 2009). Agility resulted from the vision of industry executives whose intent was to bring about a profound shift in the manufacturing paradigm to address changes in the competitive global environment. The group originally defined agility as a manufacturing system that has the capability to meet the

rapidly changing needs of the marketplace by quickly shifting among product models or between product lines (Yusuf et al. 1999).

Some scholars believed that agility as expounded by the Iacocca Institute was ill-defined and that it lacked grounding in a theoretical perspective (Burgess 1994; Yusuf et al. 1999). Consequently, after the publication of the Iacocca Institute report, a variety of subsequent academic articles dealing with the topic of agility attempted to define and explain the concept.

While agility as a business concept originated in manufacturing, agility principles can be applied to other business functions and to service industries (Katayama and Bennett 1999). The concept has been extended to agile competitors (Goldman et al. 1995), agile innovations (Wilson and Doz 2011), agile business relationships (Preiss et al. 1996), agile enterprises (Goldman and Nagel 1993; Lu and Ramamurthy 2012), agile information systems (Conboy 2009), agile workforce (Sherehiy et al. 2007; Qin and Nembhard 2010), and agile supply chains (Christopher 2000; Swafford et al. 2008), to name a few. Agility has been regarded as a necessary ingredient for improving firm competitiveness. It has been considered to help firms thrive and prosper in dynamic environments (Gunasekaran and Yusuf 2002).

Agility has risen in significance as the modern business paradigm has shifted the notion that individual businesses no longer compete as solely autonomous entities, but rather as supply chains (Lambert and Cooper 2000; Christopher 2005; Defee and Stank 2005; Stank et al. 2005). It has been recognized that in order to achieve a competitive advantage in the rapidly changing business environment, firms must align with suppliers and customers to coordinate operations and together achieve a level of agility beyond that of competitors' (Lin et al. 2006). Supply chain members must be capable of rapidly aligning their collective capabilities to

respond to changes in demand and supply (Gligor and Holcomb 2012). As supply chain agility has progressed from a conference topic to a practical imperative for most companies (White et al. 2005), agility has been highlighted as the fundamental characteristic of the "best" supply chains (Lee 2004).

Although agility has been identified as one of the most important issues of contemporary supply chain management (Lee 2004), the theoretical basis for understanding supply chain agility is fragmented (Li et al. 2008). One of the challenges associated with the development of a cohesive theoretical base for understanding supply chain agility is the change in unit of analysis within and across research articles dealing with the topic. Specifically, some articles discuss the concept of *agile supply chain*, some discuss the concept of *firm supply chain agility*, while other use the two terms interchangeably (Christopher 2000; Lee 2004; Swafford et al. 2006; Li et al. 2009). This unit of analysis ambivalence is not unique to agility research, but has been recognized as a common problem in many past research articles within the supply chain management area (Braunscheidel and Suresh 2009). The term *agile supply chain* best describes the overall agility level of respective supply chain members considered as a unit (e.g., supply chain), while the term *firm supply chain agility* best describes the focal firm's ability to be agile by reconfiguring resources within its supply chain. This research investigates agility from the perspective of the focal organization (i.e., firm supply chain agility).

Agility is a broad and multidimensional concept bridging many disciplines (Gligor and Holcomb 2012). As the positive impact of agility has gained increased recognition, researchers have offered different theoretical conceptualizations. While a comprehensive supply chain agility definition is developed in subsequent sections, it is important to present a preliminary

working definition. In essence, a firm's supply chain agility can be defined as *the firm's ability to quickly adjust tactics and operations within its supply chain to respond or adapt to changes, opportunities or threats in its environment.*

RESEARCH GAPS AND STATEMENT OF PURPOSE

The multidimensionality of agility has led to much confusion and ambiguity (Giachetti et al. 2003; Li et al. 2009; Gligor and Holcomb 2012). Elements and linkages among agility elements are underdeveloped, and it is uncommon for any two articles to adopt the same definition (Conboy 2009). Agility has been conceptualized as comprehensively as the total integration of business components (Kidd 1994) and as narrowly as the ability to accomplish rapid changeover from the assembly of one product to the assembly of a different product (Quinn et al. 1997). Scholars within and across business domains have emphasized various aspects of agility that are reflected in the somewhat divergent perspectives on the agility definitions. For example, within the manufacturing domain Booth (1995) describes it as a manufacturing vision that is a natural development from the original concept of lean manufacturing with an emphasis on cost cutting. At the other end of the spectrum, Kumar and Motwani (1995) define it as the firm's ability to accelerate activities on the critical path. The first definition emphasizes cost cutting, while the second one emphasizes the speed dimension of agility. There is little common ground between the two definitions and it seems that the authors are describing different concepts.

To add to the ambiguity, some agility definitions are a mere description of the attributes or characteristics of agile entities (Goldman et al. 1995; Zhang and Sharifi 2000). Collectively, they indicate that some commonalities across agility conceptualizations exist, but no consensus has yet been reached. A chronologic investigation of these definitions indicates that the concept has evolved over time, and researchers have expanded the construct's dimensions. However, the problem lies in the lack of rigor associated with this process. Elements have been added to agility that have little to do with the original use of the term. The Merriam-Webster (2012) dictionary describes the term agile as "nimble". Researchers have strayed away from the word's original meaning as agility has come to embody a plethora of desirable attributes and business outcomes (e.g., enriching the customer, cooperating, thriving, increasing market share, etc). This all-inclusive approach to defining agility has lead to a fragmentation of the agility theoretical base and reluctance on the practitioners' side to fully embrace its practices. For agility to reach its full potential as a business concept, it is imperative to determine what agility is and is not.

The development of supply chain agility is based upon the theoretical foundations of the broader concept of agility within the business domain. Therefore, the inconsistencies associated with agility as a business concept have been perpetuated to the concept of supply chain agility. Very few researchers provide a formal supply chain agility definition, and there is no agreement on the basic supply chain agility dimensions (Li et al. 2008). For example, Swafford et al. (2006) define it as the capability to adapt or respond in a speedy manner to a changing marketplace environment, while Costantino et al. (2012) define it as a network of

different companies integrated with streamlined material, information and financial flow, and focused on flexibility and performance.

This dissertation addresses the research gap related to the ambiguity surrounding the dimensions and definition of firm supply chain agility. In order to overcome the inconsistencies associated with agility within the business domain, a multidisciplinary literature review is employed. In addition to literature within the business domain, the sports science and military science theoretical bases are investigated to gain an in-depth understanding of the concept. Drawing upon foundational social and life science theory, this research identifies the elements of firm supply chain agility and explains the linkages among them. In order to address the definitional inconsistencies surrounding the concept, a rigorous, comprehensive definition is developed.

Due to a lack of agreement on the supply chain agility definition, different conceptual models have been used to describe the construct. As a result, a comprehensive measurement instrument has yet to be developed. The current dissertation addresses this research gap. A rigorously validated instrument to measure supply chain agility is needed to enable researchers to credibly test explanatory theories regarding causal links among capabilities, practices and performance outcomes related to this phenomenon (Sherehiy et al. 2007; Li et al. 2009).

There have been few attempts to operationalize agility from a supply chain perspective. Among those, Swafford et al. (2006) approach supply chain agility as a uni-dimensional construct, while acknowledging its multidimensionality. Two subsequent articles recognize the construct's multidimensionality. First, Li et al. (2009) identify the *alertness to change* and the *response capability* dimensions. Their model suggests that a firm's supply chain agility is

manifested in its ability to be alert and respond to changes at three levels: strategic, operational, and episodic. The resultant measurement instrument characterizes supply chain agility in terms of six factors: strategic alertness, strategic response capability, operational alertness, operational response capability, episodic alertness, and episodic response capability. While their measurement instrument acknowledges that agility can manifest itself at three levels (strategic, operational, and episodic), in essence the study only identifies two major agility dimensions: *alertness to change* and *response capability*. One significant research limitation is the lack of detail on the composition of the *response capability*. An agile supply chain is described as being alert to changes and capable of responding to changes. However, no information is offered on how the response capability is developed or what that capability entails. It is the premise of the current research that a comprehensive instrument for measuring supply chain agility would expand on the dimensions within the *response capability* category identified by Li et al. (2009).

Second, Braunscheidel and Suresh (2009) defined firm supply chain agility as a second-order construct that is formed by the first order dimensions of *demand response*, *joint planning, customer responsiveness,* and *visibility.* A significant weakness of this operationalization is the lack of theoretical rationale surrounding its development. No information is offered on how the four dimensions were identified. The current research addresses the limitations related to existing firm supply chain agility scales. Building upon foundational social and life science theory, it identifies a full pallet of the construct's dimensions and offers a theoretically rigorous operationalization of firm supply chain agility. In the process, a comprehensive measurement instrument is developed and tested.

Inconsistent usage of terms that are closely related to agility presents yet another element of complexity in any attempt to develop a concise definition of firm supply chain agility. The terms agility, flexibility, responsiveness, resilience, and adaptability are often used inconsistently. In fact, some of these terms are used interchangeably as some authors consider them to be synonymous (Giachetti et al. 2003; Li et al. 2008; Almahamid et al. 2010). To illustrate some of the inconsistencies, Christopher (2005) considers flexibility and agility as formative elements of resilience, while Hashimoto et al. (1982) suggest resilience to be a component of flexibility. Swafford et al. (2006) posit adaptability as a dimension of flexibility, while Kidd (1994) argues that adaptability is a key attribute of agility. Swafford et al. (2006) consider flexibility an antecedent to agility, while Lin et al. (2006) see flexibility as a key dimension of agility. This situation can be explained by the fact that all of these concepts deal with an entity's ability to alter its resources, operations, processes, or strategy, in order to respond to new circumstances created by change (Almahamid et al. 2010). Furthermore, they're built on, or around the idea of flexibility. This dissertation addresses the research gap associated with the inconsistent use of these terms. It provides a clear distinction between agility and other related concepts, such as flexibility, responsiveness, adaptability, and resilience, and also explores the relationship between agility and these phenomena.

There has been limited theory development in the firm supply chain agility area, as researchers are still at an early stage in identifying supply chain agility determinants (Li et al. 2008; Gligor and Holcomb 2012). For the most part, supply chain agility antecedents have been addressed at an operational level (e.g. Swafford et al. 2006; 2008). More research is needed to identify the strategic-level determinants of firm supply chain agility to further develop agility

theory within the supply chain domain. This research expands on the work of Braunscheidel and Suresh (2009) who explored the role of different managerial orientations in achieving supply chain agility. Market orientation and learning orientation are theorized to be antecedents to internal integration, external integration, and external flexibility, which in turn lead to firm supply chain agility. However, their research does not establish a direct link between market orientation and firm supply chain agility. The current research hypothesizes that market orientation (MO) has a direct impact on firm supply chain agility. Furthermore, it is the current research's premise that it is not enough to be market oriented to achieve a high level of supply chain agility; rather, a supply chain orientation (SCO) needs to be developed as well. This hypothesis is supported by literature that posits that market orientation is not sufficient for a firm's market competitiveness (Han et al. 1998; Min et al. 2007). Consistent with past marketing and supply chain management research (Kohli and Jaworski 1990; Christopher and Towill 2002; Lee 2002; Qu and Ennew 2008), it is also hypothesized that the level of environmental uncertainty is directly linked to the development of market orientation and supply chain orientation.

Another gap in understanding firm supply chain agility relates to its impact on performance. Although the benefits of agility have been widely recognized across a variety of domains (Christopher 2000; Van Oyen et al. 2001; Wilson and Doz 2011; Zhang 2011), little empirical research addresses the impact of firm supply chain agility on performance. To date, the only research addressing this important link is by Swafford et al. 2008. Their research indicates a direct link between supply chain agility and competitive business performance. The current research expands on Swafford et al.'s work by providing a more detailed evaluation of

the relationship between supply chain agility and firm performance. Firm performance is examined in terms of efficiency and effectiveness (Mentzer and Konrad 1991; Fugate et al. 2009). Traditionally, researchers have claimed agility as an attribute closely tied to the effectiveness of strategic supply chain management (Ketchen and Hult 2007; Lee 2004; Li et al. 2008). Agility has been associated with customer effectiveness, and considered the opposite of lean, which has been linked to cost efficiencies (Goldsby et al. 2006). However, based on a multidisciplinary theoretical base, the current research hypothesizes a direct positive relationship between a firm's supply chain agility and its cost efficiency. This dissertation also investigates the impact of firm supply chain agility on the firm's financial performance using secondary data.

To address the research gaps identified above, the following research questions are put forth:

1. What are the dimensions of the *firm supply chain agility* construct?
2. How is *agility* different from closely related terms such as flexibility, responsiveness, adaptability, and resilience?
3. What are some of the strategic-level antecedents of *firm supply chain agility*?
4. What is the relationship between *firm supply chain agility* and its strategic-level antecedents?
5. How does *firm supply chain agility* impact firm performance?

This dissertation builds on the theoretical base of the Resource Based View (RBV) of the firm, the Relational View (RV) theory, and the Strategy-Structure-Performance (SSP) paradigm to address these questions. Combined, these theoretical lenses drive the research hypotheses

generation and facilitate the theoretical model development. The RBV theory guides the identification of firm supply chain agility strategic antecedents. According to RBV, the identification and possession of internal strategic resources contributes to a firm's ability to create and maintain a competitive advantage (Barney 1991; Hart 1995; Crook et al. 2008). The dynamic perspective of RBV helps explain a firm's competitive advantage in changing environments and, therefore, facilitates a better understanding of how firm supply chain agility impacts performance (Priem and Butler 2001).

Firm supply chain agility is a dynamic capability that results from the firm's ability to reconfigure firm-level and supply chain-level resources. The relational view (RV) theory suggests that a firm's sources of competitive advantage may extend beyond firm boundaries. While RBV helps examine within-firm determinants of supply chain agility, the Relational View helps explain the role of inter-firm resources in achieving supply chain agility. Finally, the Strategy-Structure-Performance paradigm provides another useful theoretical framework for examining the theoretical model put forth. This theoretical lens helps examine the nature of the strategic planning required for the development of supply chain agility.

RESEARCH CONTRIBUTION

There are a number of theoretical and managerial implications associated with addressing the research gaps identified above. This dissertation contributes to theory building by addressing the ambiguity surrounding the dimensions and definition of *firm supply chain agility*. The research expands on Li et al. (2009) and Braunscheidel and Suresh's (2009) work by

fully conceptualizing the concept's multidimensionality. It identifies alertness, accessibility, decisiveness, swiftness, and flexibility as *firm supply chain agility* dimensions. Building upon these dimensions, a comprehensive definition is developed to help address definitional inconsistencies associated with the construct. Managers can use this comprehensive list of dimensions to determine what aspects of their operations and tactics should be improved to enhance the firm's supply chain agility.

The current research also provides a deeper understanding into the nature of the construct's dimensions. Based upon the sports and life sciences literature, this dissertation posits that *firm supply chain agility* dimensions can be classified into two distinct categories: cognitive and physical. The cognitive dimensions (alertness, accessibility, decisiveness) are related to information-processing, while the physical dimensions (swiftness, flexibility) are related to action-taking. For managers, the findings offer a clear distinction between the two types of capabilities that a firm must possess to achieve the desired supply chain agility level; too often, the focus on managerial attention is on physical attributes of business initiatives at the expense of cognitive and behavioral dimensions.

Another theoretical contribution of this dissertation is the development and testing of a comprehensive measurement instrument for the *firm supply chain agility* construct. Without such an instrument, no single finding related to the phenomenon can be trusted (Straub 1989). As organizations continue to adopt and develop agile management practices, the need for valid and reliable instruments to assess supply chain agility increases (Li et al. 2009). Managers can use the measurement instrument developed in this dissertation to assess not only the firm's

supply chain agility, but also its impact on firm performance in terms of cost efficiency, customer effectiveness, and financial criteria.

In addition, this dissertation facilitates theory building by distinguishing between agility and other related concepts, such as flexibility, responsiveness, adaptability, and resilience. This provides an initial attempt to develop a deeper understanding of how the disparate research on these various constructs relate to each other. A clear distinction between these concepts allows managers to better determine which initiatives to implement within their supply chains based on which capability the firm seeks to develop (e.g., agility, resilience).

Furthermore, the current research contributes to theory expansion by examining the strategic-level antecedents of *firm supply chain agility*. Building on Braunscheidel and Suresh's (2009) work, this dissertation investigates the direct link between environmental uncertainty, market orientation, supply chain orientation and *firm supply chain agility*. For managers, the research seeks to determine whether firms must have both, a market and a supply chain orientation, in order to achieve the desired supply chain agility level. These findings are intended to help guide managers on how to best distribute limited resources to enhance supply chain agility.

Finally, this dissertation contributes to theory development by providing a more detailed explanation regarding the impact of *firm supply chain agility* on firm performance. Using this dissertation's results, managers can develop a more accurate understanding of the benefits associated with supply chain agility. The use of secondary data provides credible evidence to managers regarding the positive impact of supply chain agility on the firm's financial performance.

DISSERTATION ORGANIZATION

This dissertation is organized into three chapters and two research articles. Chapter 1 provides an introduction to the phenomenon of interest, identifies the research gaps addressed in the dissertation, and presents this dissertation's potential theoretical and managerial contributions. Chapter 2 employs a multidisciplinary literature review to understand the construct's dimensions and distinguish between agility and related business phenomena (e.g., flexibility, resilience, adaptability, and responsiveness). Next, the theoretical lenses used to explore the relationship between constructs are explored. Finally, a theoretical model is developed and hypotheses are put forth. Chapter 3 presents the research methodology. This includes discussions of the data collection and analysis procedures. The remainder of this dissertation is organized in the form of two distinct research articles. The first article explores the first two research questions put forth, while the second article addresses the dissertation's last three research questions. Building on the identified findings, each article will present an in-depth discussion of the research and managerial implications, empirical research limitations, and future research opportunities.

CHAPTER 2-BUILDING THE THEORY

DIMENSIONS AND DEFINITION OF FIRM SUPPLY CHAIN AGILITY

Understanding Agility from a Manufacturing Perspective

The concept of agility, with a specific focus on agile manufacturing, has received attention from the academic and business communities for some time (Bottani 2010). Since its introduction (i.e., Iacocca Institute 1991), researchers have developed several agility frameworks that firms can employ to cope with uncertainty and gain competitive advantage (Goldman et al. 1995; Sharifi and Zhang 1999; Sherehiy et al. 2007; Jain et al. 2008; Almahamid et al. 2010). Some of the more notable conceptualizations, based on the number of citations, are discussed below.

One of the most referenced definitions of agility was introduced by Goldman et al. (1995). The authors conceptualize agility as a construct with the following strategic dimensions: enriching the customer, cooperating both internally and externally to enhance competitiveness, organizing to both adapt and thrive on change and uncertainty, and leveraging the impact of people and information. Goldman et al.'s research has served as a building block for a large number of authors who have proposed different characteristics and properties of agility. As an example, Gunasekaran (1998) views agile manufacturing as a capability to survive and prosper in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets, driven by customer-designed products and services. This definition contains elements similar to the Goldman et al. (1995) conceptualization in that it

emphasizes the capability to prosper when unforeseen changes take place and a quick response is needed. Narasimhan et al. (2006) also use the elements of uncertain and changing demand in their definition of agility. They deem production to be agile if it can efficiently change operating states in response to a changeable environment.

Other researchers provide a similar interpretation of agility, such as Sarkis (2001) who defines agility as the ability to thrive in an environment of continuous and often unanticipated change. DeVor et al. (1997) view agility as the ability of a producer of goods and services to operate profitably in a competitive environment of continuous and unpredictable change, while Sharifi and Zhang (1999) characterize agility as the ability to cope with unexpected changes, to survive unprecedented threats of business environment, and to take advantage of changes as opportunities.

Dove (1994; 1999) offers a more comprehensive definition of agility conceptualizing it as the successful exploration of competitive bases (speed, flexibility, innovation pro-activity, quality, profitability) through integration of reconfigurable resources and best practices in a knowledge-rich environment to provide customer-driven products and services in a fast changing market environment. This definition emphasizes the need for resource integration as a condition for achieving the desired state of agility. More recent definitions conceptualize agility as a paradigm that enhances firms' ability to quickly respond to customers' dynamic demands (Brown and Bessant 2003; Vinodh 2010).

Interestingly, a chronological study of the manufacturing literature shows that the initial focus of agility research was a move towards cost adaptability which seeks to reduce fixed cost and lower the break-even point (Katayama and Bennett 1999). Over time, the motivation to

achieve agility seems to be driven by a need to deliver customer value in an environment where customer requirements are becoming more customized. Agile manufacturing was posited as the means to rapidly respond to changes in demand and to meet widely varied customer requirements in terms of price, specification, quality, quantity and delivery (Katayama and Bennett 1999). In addition, agile manufacturing was shown to be an effective means of coping with the increasing internationalization of competition (Kasarda and Rondinelli 1998), the fragmentation of mass markets, and the need for cooperative production relationships (Gunasekaran 1999).

In summary, Table 2.1 provides a synthesis of the different agility definitions. The most notable finding is that the definitions reveal a variety of dimensions associated with the concept. The focus in the early years was on speed and responsiveness through the manufacturing function. By 1999, however, the concept of agility began to encompass a more external aspect. This was reflected through the inclusion of a need to respond to changing market conditions in agility definitions. Although the early definitions of agility have less commonality, there appears to be more convergence between more recent definitions.

Defining Supply Chain Agility

The shift of competition from the firm level to supply chain against supply chain has increased the need to better understand the determinants that lead to successful outcomes for the entire supply chain and not just individual members. According to Agarwal et al. (2006, p.213), "supply chain management (SCM) helps firms in integrating their business by collaborating with other value chain partners to meet the unpredictable demand of the end user" (p. 213). The premise of the authors is that an integrated supply chain is needed to cope

Table 2.1

Definitions of Agility within the Business Domain

Author	Definition
Iaccoca Institute 1991	A manufacturing system with extraordinary capabilities to meet the rapidly changing needs of the marketplace. A system that shifts quickly among product models or between product lines, ideally in a real-time response to customer demand
Nagel and Dove 1991	The ability to thrive in an environment of continuous and unpredictable change and profit from rapidly changing global markets for customized customer-driven products and services
Goldman and Nagel 1993	Dynamic, context specific, aggressively embracing change for growth that leads to winning profits, market share and customers
Dove 1994	The ability of an organization to thrive in a continuously changing, unpredictable business environment
Kidd 1994	Total integration of business components
D'Aveni 1994	The firm's ability to detect and seize market opportunities with speed and surprise
Gehani 1995	The ability of a business to grow in a competitive market of continuous and unanticipated change; to respond quickly to rapidly changing markets driven by customer-based valuing of products and services
Goldman et al. 1995	A construct having the following strategic dimensions: enriching the customer, cooperating both internally and externally to enhance competitiveness, organizing to both adapt to and thrive on change and uncertainty, and leveraging the impact of people and information
Kumar and Motwani 1995	A firm's ability to accelerate the activities on the critical path
Booth 1995	A vision of manufacturing that is a natural development from the original concept of "lean manufacturing" with an emphasis on cost cutting. It is differentiated from the lean concept by the need to become more flexible and responsive to customers
Cho et al. 1996	The capability to survive and prosper in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets, driven by customer-designed products and services

Table 2.1 Continued

Author	Definition
Gupta and Mittal 1996	A business concept that integrates organizations, people and technology into a meaningful unit by deploying advanced information technologies and flexible and nimble organizational structures to support highly skilled, knowledgeable and motivated people
Richards 1996	Enablement of enterprises to thrive in an environment of continuous and unanticipated change
DeVor et al. 1997	The ability of a producer of goods and services to operate profitably in a competitive environment of continuous and unpredictable change
Fliedner and Vokurka 1997	An ability to produce a broad range of low-cost, high quality products with short lead times in varying lot sizes, built to individual customer specification
Quinn et al. 1997	The ability to accomplish rapid changeover from the assembly of one product to the assembly of a different product
Bullinger 1999	Mobility in an organization's behavior towards an environment of continually changing markets. Characterized as being in a process of constant re-determination, or self-organization, self-configuration, and self-teaming
Dove 1999	Ability to thrive in a time of uncertain, unpredictable and continuous change
Sharifi and Zhang 1999	The ability to cope with unexpected changes, to survive unprecedented threats of business environment, and to take advantage of changes as opportunities
Gunasekaran 1998; 1999	Capability for surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets
Yusuf et al. 1999	The successful exploration of competitive bases through integration of reconfigurable resources and best practices in a knowledge-rich environment to provide customer-driven products and services in a fast changing market environment
Zhang and Sharifi 2000	A combination of three elements: 1) agility drivers, which are changes/ pressures from the business environment that necessitate search for new ways of running a business in order to maintain competitive advantage, 2) agility capabilities, which are essential capabilities that a firm needs in order to positively respond to and take advantage of the changes, and 3) agility providers, which are the means whereby the so-called capabilities could be obtained
Sanchez and Nagi 2001	Characterized by: 1) cooperativeness and synergism (possibly resulting in virtual corporations), 2) a strategic vision that enables thriving in face of continuous and unpredictable change, 3) the responsive creation and delivery of customer-valued, high quality and mass customized goods/services, 4) nimble organization structures of a knowledgeable and empowered workforce, and 4) facilitated by an information

Table 2.1 Continued

Author	Definition
	infrastructure that links constituent partners in a unified electronic network
Sarkis 2001	The ability to thrive in an environment of continuous and often unanticipated change
Conboy and Fitzgerald 2002	The continual readiness of an entity to rapidly or inherently, proactively or reactively, embrace change, through high quality, simplistic, economic components and relationships with its environment
Gunasekaran and Yusuf 2002	The capability of an organization, by proactively establishing virtual manufacturing with and efficient product development system, to: 1) meet the changing market requirements, 2) maximize customer service level, and 3) minimize the cost of goods, with an objective of being competitive in a global market and for an increased chance of long-term survival and profit potential
Yusuf et al. 2004	Ability to respond, in real time to the unique needs of customers and markets
Narasimhan et al. 2006	The ability to respond to customer demands in a timely, effective manner
Helo et al. 2006	The capability of an organization to thrive in the competitive environment of continuous and unanticipated changes and to respond quickly to rapidly changing markets driven by customer based valuing of products and services
Eshlaghy et al. 2008	A model that integrates technology, human resources through information and communication infrastructure. It provides flexibility, speed, quality, service and efficiency and enables firms to react deliberately, effectively, and change the environment in a coordinated manner
Almahamid et al. 2010	An organization's abilities to adapt its processes, strategies, production lines, resources, and so on to respond to the new circumstances created by change
Vickery et al. 2010	Rapid responsiveness to the needs and wants of customers and potential customers
Zhang 2011	A comprehensive response to the business challenges of profiting from rapidly changing, continually fragmenting markets for high performance, high quality, customer configured goods/services
Yauch 2011	A firm's ability to succeed in a turbulent environment

with uncertainty of demand. Moreover, they assert that nonintegrated manufacturing processes, non-integrated distribution processes and poor relationships with suppliers and

customers will lead to failure. Agility has been suggested as the means through which the supply chain is able to adapt to the changing needs of the market (Sharp et al. 1999; Christopher 2000; Jain et al. 2008).

Very few research articles provide formal definitions of supply chain agility (Sharp et al. 1999; Swafford et al. 2006; Ismail and Sharifi 2006, Li et al. 2008). Most articles have focused on the identification of characteristics that a supply chain must have in order to be truly agile (e.g., Christopher 2000). In addition, a portion of the literature presents frameworks of supply chain agility that closely resemble ones examined for manufacturing agility. For example, Bal et al. (1999) propose a virtual teaming model for supply chain agility, while Tolone (2000) suggests the use of real time and asynchronous collaborative technology as a means to increase supply chain agility.

While there is no single accepted definition of supply chain agility, the current definitions share common terms and themes, suggesting that a certain degree of consensus exists. Sharp et al. (1999) conceptualize supply chain agility as the ability of a supply chain to rapidly respond to changes in market and customer demand, while Ismail and Sharifi (2006) describe it as the capability of the supply chain and its members as a whole to rapidly align the network and its operations to dynamic and turbulent customer requirements. Both of these definitions are similar to those for manufacturing and organizational agility in that they emphasize the capacity to rapidly respond to changing customer needs. Li et al. (2008) suggest that agility is the result of integrating alertness to internal and environmental changes that present both opportunities and challenges, with a capability to use resources in responding (proactively/reactively) to such changes, all in a timely, and flexible manner. While this

definition is akin to previous ones, the conceptualization also provides the route for achieving agility, and the conditions that need to be present in order for firms to form agile supply chains.

The inconsistencies surrounding the concept of agility itself are also found across definitions of supply chain agility (Table 2.2). While various supply chain agility conceptualizations address different aspects of the construct, a comprehensive definition is lacking. The literature review indicates that most of the research in the area of supply chain agility has been done through the lens of manufacturing, with a focus on the role of manufacturing in achieving supply chain agility.

Identifying the Dimensions of Supply Chain Agility

It is the premise of this research that a comprehensive definition of supply chain agility cannot be developed unless the multidimensionality of the concept is fully explored. To facilitate an in-depth understanding of the concept, the sports science and military science theoretical bases are investigated, in addition to the agility-related literature within the business domain. The effort culminates in the identification of five firm supply chain agility dimensions: alertness, accessibility, decisiveness, swiftness, and flexibility; a classification of the dimensions is also offered. The identification and classification of the dimensions of agility enables the development of a comprehensive definition of the construct. The following subsections present the literature review that lead to the emergence of the supply chain agility dimensions.

Table 2.2

Definitions of Agility within a Supply Chain Context

Author	Definition
Global Logistics Research Team 1995	How well a firm responds to customers' changing needs; marked by the abilities to meet unique customer requests and adapt to unexpected circumstances
Bal et al. 1999	The basis for achieving competitive advantage in changing market conditions
Sharp et al. 1999	The ability of a supply chain to rapidly respond to changes in market and customer demand
Van Hoek et al. 2001	A management concept centered around responsiveness to dynamic and turbulent markets and customer demand
Lee 2002	Supply chains that utilize strategies aimed at being responsive and flexible to customer needs
Christopher 2000	A business-wide capability that embraces organizational structures, information systems, logistics processes, and in particular, mindsets; the ability of an organization to respond rapidly to changes in demand, both in terms of volume and variety
Conboy and Fitzgerald 2001	The continual readiness of an entity to rapidly or inherently, proactively or reactively, embrace change, through high quality, simplistic, economic components and relationships with its environment
Aitken et al. 2002	The ability to have visibility of demand, flexible and quick response and synchronized operations
Lee 2004	The ability to react quickly to unexpected or rapid shifts in supply and demand
Ismail and Sharifi 2006	The capability of the supply chain and its members as a whole to rapidly align the network and its operations to dynamic and turbulent customer requirements

Table 2.2 Continued

Author	Definition
Jain et al. 2008	The capability to survive and prosper by reacting quickly and effectively to changing markets
Li et al. 2008	The result of integrating alertness to internal and environmental changes (opportunities/challenges) with a capability to use resources in responding (proactively/reactively) to such changes, all in a timely, and flexible manner
Vinodh et al. 2011	The ability of a supply chain to rapidly respond to changes in market conditions and customer demands thereby enabling the attainment of competitive advantage
Costantino et al. 2012	A network of different companies, possessing complementary skills and integrated with streamlined material, information and financial flow, focusing on flexibility and performance

I. Alertness

Alertness is defined in this research as *the ability to quickly detect changes, opportunities, and threats.* The *alertness* theme emerged across a variety of domains. Within manufacturing research, Sharifi and Zhang (1999) recognize that agile organizations need a basic ability that consists of sensing, perceiving, and anticipating changes in the business environment. Zhang and Sharifi (2000) divided agility capabilities into four major categories: responsiveness (ability to identify, respond to, and recover from changes quickly, reactively or proactively), competency (ability to efficiently and effectively realize enterprise objectives), flexibility/adaptability (ability to implement different processes and apply different facilities to achieve the same goals), and speed (ability to complete an activity as quickly as possible). Although it introduces some of the possible dimensions of agility, Zhang and Sharifi's conceptualization is problematic. One limitation of this conceptualization is the lack of

distinction between the ability to detect changes and the ability to respond to changes. These two distinct capabilities are grouped under the *responsiveness* umbrella. This dissertation research expands on Zhang and Sharifi's work and posits alertness as a distinct dimension of agility. Other research articles also recognize the role of alertness in the design of agile manufacturing systems (Goldman et al. 1995; Almahamid et al. 2010 Inman et al. 2011; Vinodh and Prasanna 2011; Zhang 2011).

The role of alertness in achieving the desired level of agility is also emphasized within information systems and information systems development research. Sarker and Sarker (2009) argue that agility lies in environmental scanning and sense-making routines for anticipating and recognizing possible or imminent crises, while other authors emphasize the important role of sensing market opportunities and threats (Tseng and Lin 2011; Lu and Ramamurthy 2012; Tallon and Pinsonneault 2011). Within a supply chain management context, Christopher (2000) was the first to acknowledge that, to be truly agile, a supply chain must be capable of *reading* and *responding* to real demand. He refers to this capability as market sensitivity. One limitation of Christopher's interpretation is that although he recognizes the importance of *reading* customers' requirements, he doesn't conceptualize it as a distinct capability; he places it in the same category with the *responding* to real demand capability. Another limitation of Christopher's research is that it only recognizes the importance of reading demand information, with no reference to supply. Other supply chain researchers also recognize that agility requires a timely awareness of change and adopt the market sensitivity dimension introduced by Christopher (Lin et al. 2006; Agarwal et al. 2007; Jain et al. 2008). However, it was Li et al. (2008) that first conceptualized alertness as a distinct dimension of supply chain agility. These

authors argue that agile supply chains must be alert to changes, within the supply chain itself and within the surrounding environment. This dimension of agility manifests itself through sensing emerging market trends, listening to customers, and monitoring real demand through daily point-of-sale data (Li et al. 2008; 2009).

Researchers within the sports science discipline have a somewhat shared definitional understanding of agility. Sheppard and Young (2006) describe it as a rapid whole-body movement with change of velocity or direction in response to a stimulus, while Farrow et al. 2005 define agility as basic movements requiring the player to perform sudden changes in body direction. Sports science research consistently recognizes the importance of alertness as a dimension of agility. The ability of players to execute agility tasks is considered dependent upon factors such as visual-scanning techniques, visual-scanning speed, visual processing, perception and anticipation (Chelladurai 1976; Abernethy et al. 1999; Young et al. 2002; Sheppard and Young 2006). These factors are reflected in the players' on-field agility (Gore 2000). It has been suggested that elite performers differ from non-elite performers in their ability to anticipate the opponents' movements (Abernethy and Russell 1987). Some agility tests indicate that high-performance sports players initiate a change of direction movement before the opponent's ball release due to anticipation of the other players' movements (Sheppard and Young 2006). Visual search and anticipation research have also shown that highly skilled athletes are able to successfully predict the action of an opponent before it is carried out (Bradshaw et al. 2010). The national protocol for the assessment of agility performance in team-sport athletes also recognizes the role of alertness and suggests that the athletes' ability to successfully use agility

maneuvers in the actual game depends on factors such as visual processing, timing, reaction time, perception, and anticipation (Ellis et al. 2000).

Military science researchers have extensively investigated the concept of agility. While various conceptualizations of the construct have been introduced in this domain, some commonalities do exist across definitions. Dekker (1999) sees agility as the ability to perceive an upcoming threat and respond to it quickly, while the US Army defines it more simply as the ability of friendly forces to act faster than the enemy (US Army 1997). It has been suggested that creating an agile military force requires speeding up the so-called OODA (observe, orient, decide, act) loop (Fewell and Hazen 2005). The concept of an OODA loop was developed by military strategist and USAF Colonel John Boyd, and was originally applied at the operational and strategic levels in military combat operations. The alertness dimension of agility is captured within the *observe* and *orient* stages of the loop and is a prerequisite to an agile response. Some military science researchers refer to the alertness capability as situational awareness, and describe it as the perception of environmental elements with respect to time and space (Dekker 2006; Sheffer 2006). The speed of recognition of environmental elements is considered critical (Alberts 2007). In combat, military forces require early awareness of upcoming threats. The quicker changes are detected, the sooner the response can be deployed.

II. Accessibility

Accessibility emerged as the second dimension of firm supply chain agility. It is defined in this research as *the ability to access relevant data.* Research suggests that once a change is detected through the alertness capability, firms must also be able to access relevant data to

decide how to provide an agile response (Gunasekaran 1998; Sharp et al. 1999; Jain et al. 2008; Vinodh and Prasanna 2011; Tseng and Ling 2011; Lu and Ramamurthy 2012).

Supply chain-wide information access is recognized as a key requirement for supply chain agility (Vinodh and Prasanna 2011; Gligor and Holcomb 2012). In his seminal article, Christopher (2000) argues that agile supply chains must possess a number of distinguishing characteristics. Agile supply chains must be *virtual;* that is, they must be information-based rather than inventory-based. Supply chain members must share real-time demand, inventory, and production information (Ahn et al. 2012). The creation of virtual supply chains allows all supply chain members to access relevant data and make informed decisions about how to respond to changes detected in the environment. Lin et al. (2006) refer to the capacity to access information as *information integration,* and describe it as the ability to use information technology to share data between buyers and supplies. Information integration can be considered the infrastructure needed to create a virtual supply chain (Christopher et al. 2004; Jain et al. 2008).

Manufacturing research also suggests that a requirement for designing agility is the creation of an environment where relevant information can be accessed. Goldman et al. (1995) consider the formation of virtual partnerships to be one of the four primary principles of agility. This perspective is supported by other manufacturing research articles that identify virtual enterprises, information technology and communication as key enablers of agility (Gunasekaran 1998; Sharp et al. 1999; Khalil and Wang 2002; Cao and Dowlatshahi 2005; Eshlaghy et al. 2010; Zhang 2011; Costantino et al. 2012). Information systems and information systems development research also provide substantial empirical evidence for considering information

integration as a key enabler of agility (Clark et al. 1997; Zaheer and Zaheer 1997; Gosain et al. 2005; van Oosterhout et al. 2006; Fink and Neumann 2007; Mathiassen and Vainio 2007; Zhang and Sharifi 2007; Goodhue et al. 2009; Tseng 2011; Lu and Ramamurthy 2012). A high level of integration makes possible timely and accurate information gathering and sharing (Lu and Ramamurthy 2011). Real-time access to information allows supply chain members to quickly detect changes in customers' needs (Overby et al. 2006). Sheffer (2006) considers the ability to provide an agile response contingent upon effective information collection and dissemination. This perspective is also shared by Atkinson and Moffatt (2005) who argue that information availability is a necessary condition for agility.

III. Decisiveness

Defined in this research as *the ability to make decisions resolutely, decisiveness* was identified as the third dimension of firm supply chain agility. Sports science and military science research suggest that agility is dependent upon the ability to make resolute decisions using the available information. Motor learning researchers have recognized the role of decision making in agility tasks. They managed to isolate the decision-making time of players in order to evaluate its contribution to agility performance (Sheppard and Young 2006). Decision-making time is measured by the time elapsed between the moment a stimulus is presented to the player and the player's movement initiation (Bradshaw et al. 2010). Researchers control the alertness and accessibility aspects of agility by presenting the stimulus to the player (limited need for detection) and by offering the information on how to respond to the stimulus (limited need for information accessibility).

The impact of decision-making abilities on agility has been investigated across a variety of sports-related contexts (Chelladurai 1976). Helsoen and Pauwels (1988) presented expert and novice soccer players with a life-size film display of various tactically-oriented patterns of soccer drills. The subjects were asked to physically respond to the footage when the ball appeared to be kicked toward them by shooting for goal, passing to a team mate, or dribbling past an opponent. The simulation revealed that expert players possess superior decision-making skills as compared to novice players. Research shows that superior performance in open-skilled sports is ultimately determined by effective decision-making skills (Abernethy 1991). Offensive players, who demonstrate proficient agility, employ superior decision-making skills in response to the movements and body positions of the opposing defenders (Sayers 1999). Wheeler and Sayers (2010) research of rugby players investigated the role of decision-making abilities when executing agility tasks. The authors concluded that decision-making drills must be incorporated in agility training programs (Wheeler and Sayers 2010). Their findings concur with other research that has shown that the inclusion of decision-making elements results in different levels of agility performance (Farrow et al. 2005; Sheppard and Young 2006; Bradshaw et al. 2010). Within Australian Rules football, decision-making skills were found to be important agility enablers as they help offensive players successfully evade opponents (Bradshaw et al. 2010).

In their definition of agility, Young et al. (2002) recognize that the two main components of agility are change of direction speed and decision-making factors. Other agility conceptualizations also acknowledge the contribution of decision-making abilities to agility performance in sports (Chelladurai 1976; Abernethy et al. 1999; Sheppard and Young 2006).

Research also suggests that, as the complexity of the task increases, decision making skills become more important (Sheppard and Young 2006). The increase in complexity affects an athlete's performance as evidenced by the weak correlation between straight sprinting ability and the ability to perform complex agility tasks (Tsitskarsis et al. 2003). The decision-making component of agility can help explain why straight sprinting performance (no decision-making required) has little to do with agility performance. Previous research has observed less than fifty percent commonality between reactive (decision required) and pre-planned (no decision required) agility performance (Farrow et al. 2005).

In a supply chain context, Christopher (2000) makes a clear distinction between speed (meeting customer demand through shortened delivery lead times) and agility (responding quickly to changes in demand in terms of both volume and variety). Military science research also recognizes the importance of decisiveness. The *decide* phase is one of the components of the OODA (observe, orient, decide, act) loop (Fewell and Hazen 2005). A three-step sequential process takes place during the *decide* phase: options generation, best option selection, and best option adaptation. Speeding up the *decide* phase is suggested to result in a more agile response (Dekker 2006).

The above literature review indicates that in order to develop supply chain agility it is not enough to create the abilities to quickly detect changes (alertness) and access relevant information on how to deal with changes (accessibility). Firms must also foster the ability to make resolute decisions on how to respond to changes (decisiveness). Combined, the alertness, accessibility, and decisiveness dimensions of agility form the cognitive area of firm supply chain

agility. These dimensions are related to information-processing and allow the firm to determine what actions to take in response to changes, opportunities, or threats.

IV. Swiftness

Research suggests that once a decision is made on how to respond to changes, entities must be able to quickly implement those decisions (Sharp et al. 1999; Gunasekaran and Yusuf 2002; Lin et al. 2006; Alberts 2007; Mackley et al. 2008; Jain et al. 2008). The *ability to implement decisions quickly* is defined as *swiftness.* This element emerged as the fourth dimension of firm supply chain agility. In the Merriam-Webster (2012) dictionary definition of agility, s*wiftness* is recognized as a core characteristic of the concept. Christopher (2000) suggests that one of the required capabilities of agile supply chains is quickness, and defines it as the ability to complete an activity as quickly as possible. This ability is consistently recognized as a key enabler of agility across supply chain management research (Sharp et al. 1999; Lin et al. 2006; Jain et al. 2008). Swiftness is also captured within Li et al.'s (2008; 2009) *response capability* dimension of firm supply chain agility. Kumar and Motwani (1995) refer to the *swiftness* dimension of agility as the ability to accelerate activities on a critical path.

Manufacturing research provides additional support for considering swiftness a dimension of agility. Sharifi and Zhang (1999) argue that quickness is one of the necessary capabilities of an agile organization. They describe it as the ability to carry out tasks and operations in the shortest possible time. Kidd (1994) also recognizes that agile entities are fast moving, and Zhang (2011) considers quickness a characteristic of agile firms. In fact, agility as a business concept is centered around *speed* (Gunasekaran and Yusuf 2002). In one of the most

frequently referenced articles on agile manufacturing, Gunasekaran (1998) identifies elements of swiftness (e.g., rapid partnership formation) as key agility enablers. A review of agility definitions (Table 2.1) reveals that most conceptualizations of the construct place significant emphasis on *speed* (Iaccoca Institute 1991; Nagel and Dove 1991; Gehani 1995; Gupta and Mittal 1996; Quinn et al. 1997; Narasimhan et al. 2006; Eshlaghy et al. 2008; Zhang 2011).

Sports and military science research also recognize the enabling role of swiftness in fostering agility. Research on the effects of agility training on athletic power performance indicates that agility is highly dependent on the athlete's speed of movement (Sporis et al. 2010). Various sports agility tests have also identified change of direction speed as one of the pivotal components of agility (Young et al. 2002; Farrow et al. 2005). While the terminology might slightly vary across research articles (e.g., quickness, rapidness, swiftness, speed, velocity), a majority recognize swiftness as an essential component of agility (Clarke 1959; Mathews 1973; Draper and Lancaster 1985; Bloomfield et al. 1994; Moreno 1995; Twist and Benicky 1996; Sayers 2000; Young et al. 2002; Tsitskarsis et al. 2003; Sheppard and Young 2006). Military science research also acknowledges this agility dimension by emphasizing the role of speed of movement (Dekker 2006) and speed of action (Alberts 2007; Mackley et al. 2008) in facilitating an agile response.

V. Flexibility

Flexibility is defined as the *ability to modify the range of tactics and operations to the extent needed.* This element was identified as the fifth dimension of firm supply chain agility. Research suggests that a firm's response to changes depends on the flexibility of its supply

chain tactics and operations (Hong et al. 1996; Christopher and Towill 2002; Swafford et al. 2006; Kumar and Deshmukh 2006; Swafford et al. 2008; Eshlaghy et al. 2010; Jacobs et al. 2011; Costantino et al. 2012). In a sports context, the athlete's mobility of joints (i.e., flexibility) controls the range of quick adjustments the athlete can perform. The type of direction change (agility) performed will be dependent on the flexibility of the specific body parts involved in the exercise. Similarly, a firm's supply chain operates within a specific range, and the firm's supply chain agility (i.e., adjustment of tactics and operations) will be constrained by that range. For example, the firm's supply chain cannot quickly produce more items than its fixed manufacturing capacity allows.

Supply chain agility literature recognizes the role of flexibility in providing an agile response. Empirical research found a direct positive relationship between procurement and manufacturing flexibility and supply chain agility (Swafford et al. 2006). In their framework, Swafford et al. consider supply chain agility as an externally focused capability that is derived from flexibility (internally focused competency) in supply chain processes. Research also indicates that supply chain flexibility directly and positively impacts supply chain agility (Swafford et al. 2008). Other supply chain researchers recognize the role of flexibility. In their definition of supply chain agility, Li et al. (2008; 2009) consider flexibility to be a core aspect of the construct. Similarly this perspective finds support in a number of supply chain agility frameworks (Christopher 2000; Lin et al. 2006; Jain et al. 2008).

Flexibility has long been identified as a key agility dimension across manufacturing research. In fact, agility as a business concept was coined in relation to flexible manufacturing systems (Nagel and Dove 1991). The idea of manufacturing flexibility was subsequently

extended into a wider business context, and the concept of agility as an organizational trait was born (Christopher and Towill 2002). The role of flexibility in providing an agile response is highlighted within several agility definitions. Hong et al. (1996) define agility as flexibility and rapid response to market demands, while Eshlaghy et al. 2008 describe it as a model that provides flexibility. In one of the most referenced frameworks of manufacturing agility, Sharifi and Zhang (1999) propose flexibility to be one of the capabilities that an agile organization must possess. This perspective is supported by a number of empirical research articles within the manufacturing realm (Yusuf et al. 1999; Gunasekaran and Yusuf 2002; Kumar and Deshmukh 2006; Eshlaghy et al. 2010; Jacobs et al. 2011; Costantino et al. 2012).

Sports science researchers also consider flexibility to be a key element of agility. In their research on agility training, Sporis et al. 2010 highlight the impact of flexibility on agility. Research shows that agility performance can be improved through flexibility training (Wong et al. 2011). Military science research provides additional support for considering flexibility as an important element of agility. This body of literature recognizes that built-in flexibility is needed for agile military response (McNaughter et al. 2000; Atkinson and Moffat 2005).

The review of the agility literature has led to the identification of five dimensions of the concept. The examination of previous research also guided the classification of these dimensions into two higher echelon categories: physical and cognitive. Research suggests that swiftness and flexibility represent the physical dimensions of firm supply chain agility; alertness, accessibility and decisiveness exemplify the cognitive dimensions of the concept. The cognitive dimensions of firm supply chain agility are related to information-processing and help firms

determine what actions to take, while the physical dimensions are related to action-taking and enable firms to implement those actions (see Table 2.3).

In order to clearly establish the relationship between supply chain agility and its dimensions, it is important to determine whether the supply chain agility construct is reflective or formative. Three theoretical considerations can help distinguish formative models from reflective ones (Coltman et al. 2008). The first theoretical criterion is the nature of the construct. In reflective models the latent construct exists independent of the measures used, while in formative models the latent construct is determined as a combination of its indicators (Rossiter 2002; Borsboom et al. 2003). The second theoretical consideration pertains to the direction of causality between items and the latent construct. In reflective models variation in the construct causes variation in item measures, while in formative models variation in item measures causes variation in the construct (Bollen and Lennox 1991; Edwards and Bagozzi 2000; Diamantopoulos 2006). The third theoretical criterion considers the characteristics of the items used to measure the construct. In reflective models items are manifested by the construct and share a common theme. In formative models items define the construct and need not share a common theme (Rossiter 2002; Jarvis et al. 2003). Based on these theoretical considerations, firm supply chain agility is operationalized as a second-order formative construct with the first order factors of alertness, accessibility, decisiveness, swiftness and flexibility (Figure 2.1).

Building on the identified dimensions of firms supply chain agility, the following comprehensive definition is introduced: *A firm's supply chain agility is manifested through the firm's cognitive and physical capabilities that enable the firm to quickly detect changes, opportunities and*

Table 2.3

Summary and Classification of Firm Supply Chain Agility Dimensions

Dimension	Definition	Type
Alertness	Ability to quickly detect changes, opportunities and threats	Cognitive Dimensions
Accessibility	Ability to access relevant data	
Decisiveness	Ability to make decisions resolutely	
Swiftness	Ability to implement decisions quickly	Physical Dimensions
Flexibility	Ability to modify the range of tactics and operations to the extent needed	

threats (alertness), access relevant data (accessibility), make resolute decisions on how to act (decisiveness), quickly implement decisions (swiftness) and modify its range of supply chain tactics and operations to the extent needed to implement the firm's strategy (flexibility).

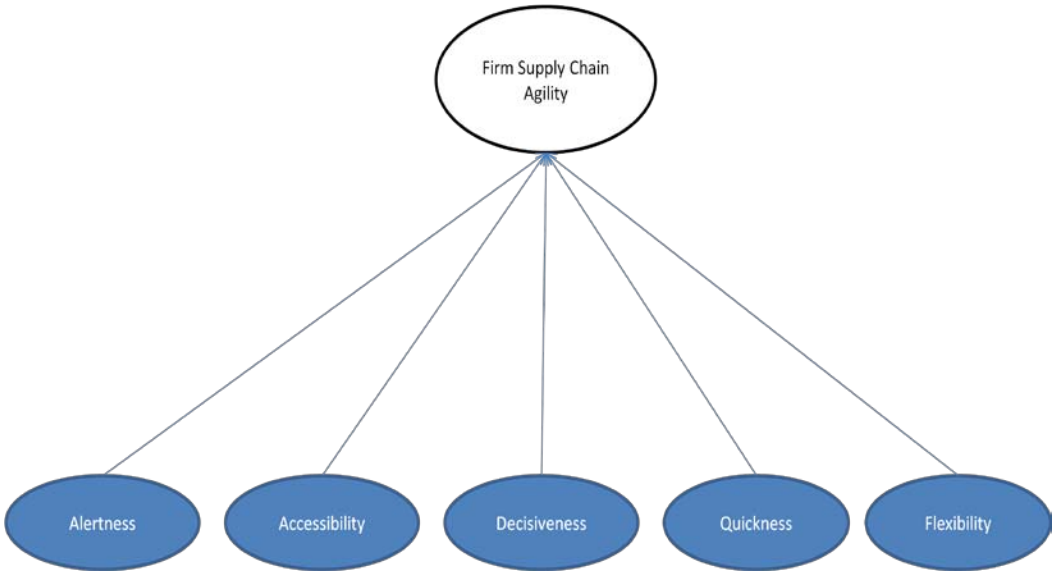

Figure 2.1

Dimensions of Firm Supply Chain Agility

RELATIONSHIP OF AGILITY TO OTHER CONCEPTS

Several terms are used interchangeably for agility including flexibility, responsiveness, and adaptability (Giachetti et al. 2003; Li et al. 2008; Almahamid et al. 2010). This section offers a clear distinction between agility and these other related concepts. This differentiation is needed to gain a deeper understanding of agility and how the concept can be positioned against the backdrop of research addressing related business phenomena. In the process, the relationship between agility and these phenomena is explored as well.

Agility and Flexibility

Although the relationship between agility and flexibility has been addressed in the previous section, a few additional comments are needed. The Merriam-Webster (2012) dictionary describes the term agile as “nimble”, “able to move with quick ease”, while flexible is defined as “capable of being flexed”. The divergence in the two definitions centers on two key terms: speed and elasticity. Despite these differences, researchers use them interchangeably (Giachetti et al. 2003). This can be explained by the fact that attributes have been added to agility and flexibility that have little to do with the core meaning of these terms.

Most definitions of organizational flexibility emphasize the ability to adapt and respond to change (Sherehiy et al. 2007). This aspect of flexibility is also associated with agility. However, there is no mention of speed within conceptualizations of flexibility while agility is centered on speed. For example, Reed and Blunsdon (1998) describe organizational flexibility as an organization’s capacity to adjust its internal structures and processes in response to changes in the environment. On the other hand, organizational agility represents the firm’s capacity to

quickly adjust its structures and processes in response to changes in the environment. This leads to the conclusion that an organization can be flexible and not necessarily agile. Consistent with the dictionary definitions and the literature reviewed in the previous section, this dissertation suggests that the two terms are distinct concepts, with flexibility being a dimension of agility.

Agility and Responsiveness

The term responsiveness was first used by supply chain management scholars to refer to specific customer service practices. La Londe et al. (1988) regard error correction, after-sales service, and effective handling of information requests to be components of responsiveness. Davis and Manrodt (1996) use the term for any handling of individual customer requests beyond traditional service measures, while Stank et al. (1996) consider responsiveness to be comprised of flexibility, provision of emergency services, and the ability to handle changes.

At its most basic level, responsiveness implies a reaction or reply to a stimulus (Merriam-Webster 2012). A comparison of the agility and responsiveness definitions suggests that the terms represent distinct concepts: one emphasizes *speed* while the other implies *reaction*. However, some scholars have considered responsiveness and agility to be synonymous and conceptualized both constructs as the ability to respond to customer demand (Li et al. 2008). To illustrate, Katayama and Bennett (1999) consider agility as responsiveness to customer requirements.

A number of supply chain agility frameworks consider responsiveness to be one of the capabilities of agile supply chains, and define it as the ability to identify changes, respond to them quickly, reactively or proactively, and recover from them (Sharp et al. 1999; Christopher

2000; Giachetti et al. 2003; Lin et al. 2006; Jain et al. 2008; Almahamid et al. 2010). This dissertation also positions responsiveness as one of the characteristics of agile supply chains. There are, however, a couple of weaknesses associated with this conceptualization of responsiveness. The very etymology of the word suggests that responsiveness implies reaction to a stimulus. Therefore, it is questionable whether the word "proactive" belongs in the above definition. Also, it is resilience that can best be described as the ability to recover from changes, not responsiveness (Pettit et al. 2010). In accordance with the original meaning of the word, responsiveness can best be described as quick response to change.

To summarize, this dissertation research is positioning agility and responsiveness as distinct concepts, with agility being an enabler of responsiveness. Agility is considered a *sine qua non* capability that supply chains must possess in order to be responsive. While a supply chain might be agile, and therefore have the capability to quickly respond to changes, it does not imply that the agile supply chain will always be responsive. A sports science analogy can be used to illustrate the relationship between the two terms. An agile athlete might not choose to react to an opponent's action, if the response is not part of the athlete's strategy. Similarly, an agile supply chain might be responsive to profitable customers, and not so responsive to less profitable customers. Agility is a capability that firms can employ to quickly respond to changes *when* dictated by the firm's strategy.

Agility and Adaptability

The origins of adaptability and adaptive organizations can be found in the contingency approach in organizational research. Contingency theories are classes of behavioral theory proposing that there isn't one universal way of managing or organizing a company, and that the

organizing approach is dependent on the situational constraints of the environment in which the firm operates (Hatch 1997; Donaldson 2001; Vecchio 2006). The premise of this perspective is that organizations have to interact with their environments in order to be successful. This implies that organizations cannot be considered and analyzed in isolation of the environment. According to contingency theory, organizational effectiveness can be achieved by fitting the characteristics of the organization to contingencies that reflect the situation of the organization (Donaldson 2001). In order to maintain effectiveness, organizations have to adapt over time to fit changing contingencies. The main contingencies considered to shape the organization are the environment, organizational size, and organizational strategy (Sherehiy et al. 2007).

The etymology of the word adaptability, according to the Merriam-Webster (2012) dictionary, suggests that the term best represents the capability of "being or becoming adapted". Definitions of adaptability in a business context also suggest that the construct is distinct from agility. For example, Katayama and Bennett (1999) define adaptability as the ability of a firm's production system to adjust or modify its cost performance according to demand. Unlike definitions of agility, definitions of adaptability do not consider "speed" or "quickness" to be attributes of the concept.

Some research articles distinguish between agility and adaptability based on the level of changes the supply chain tries to embrace. Lee (2004) suggests that an agile supply chain has the ability to quickly react to unexpected or rapid shifts in supply and demand, while an adaptable supply chain can adjust its own design to meet structural shifts in markets. This dissertation considers agility and adaptability to be distinct concepts, with agility being an enabler of adaptability. Agility adds the speed component to adaptability. It enables entities to

quickly adapt to changes. Agility is not a necessary condition for adaptability. However, agility does facilitate *quicker* adaptation. This interpretation is consistent with the agility definition developed in this dissertation, and the etymology of the two terms.

A brief chronological review of research on how organizations cope with uncertainty and change can help explain why some scholars use the terms interchangeably. In the 1960s and 1970s scholars used the terms adaptability and adaptivity to investigate how the organization's form, structure, and degree of formalization influence the ability to cope with changes and adapt (Burnd and Stalker 1961; Hage and Aiken 1969; Hage and Dewar 1973). In the 1980s, the research was more focused on organizational flexibility (Sherehiy et al. 2007). At the beginning of the 1990s, agility emerged as a new solution for managing dynamic and changing environments (Nagel and Dove 1991). Adaptability, flexibility and agility represent the evolution of the idea that entities are able to adjust. The agile entity is simply the latest stage of development of this idea (Sherehiy et al. 2007) as it implies adaptation in a swift manner.

Agility and Resilience

Traditional risk management techniques are inadequate in their ability to assess the complexities of supply chains, evaluate the intricate interdependencies of threats, and prepare an enterprise for the unknowns of the future (Hertz and Thomas 1983; Starr et al. 2003). In response to these limitations, many supply chain researchers have turned to the concept of resilience (Craighead et al. 2007; Pettit et al. 2010; Blackhurst et al. 2011). Similar to agility, resilience is a multidimensional and multidisciplinary concept. The multidimensionality of the construct is evident in the various definitions of resilience. Within a supply chain context, Pomomarov and Holcomb (2009, p. 131) define resilience as "the adaptive capability of the

supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function". This definition resulted from a synthesis of various research areas including ecology, psychology, economics, organizational, and supply chain management. From the firm's perspective, supply chain resilience can be described as a firm's ability to recover from disruptive events (Blackhurst et al. 2011). Ecological science researchers refer to resilience as the ability of an ecosystem to rebound from a disturbance while maintaining diversity, integrity, and ecological processes (Folke et al. 2004).

The Merriam-Webster (2012) dictionary defines resilience as "the capability of a strained body to recover its size and shape after deformation caused especially by compressive stress". Considering this basic meaning, resilience appears to have little in common with agility. However, both constructs are intended to help organizations cope with uncertainty and emphasize the ability to respond and adapt to change. In fact, some conceptualizations of the two terms are almost identical. Fiksel (2006) describes resilience as the capacity of an enterprise to survive, adapt, and grow in the face of turbulent change, while Cho et al. (1996) define agility as the capability to survive and prosper in a competitive environment of continuous and unpredictable change.

For purposes of this dissertation, resilience is described as "the ability of a system to return to its original state or move to a new, more desirable state after being disturbed" (Christopher and Peck 2004, p. 2). Consistent with this definition of resilience, agility is considered an enabler of resilience. Agility adds the speed component to resilience and can help a resilient system *quickly* return to its original state or move to a new, more desirable state

after being disturbed. Being able to quickly react to unpredictable events is a distinct advantage in an uncertain environment (Christopher and Peck 2004). While not a necessary condition for being resilient, agility can be a source of competitive advantage by reducing the amount of time a system needs to recover.

THEORETICAL FOUNDATIONS

Several theoretical frameworks are used in this dissertation to guide the development of a research model and its subsequent empirical investigation. The resource-based view, the relational view, and the strategy-structure-performance theories are used to support the proposed research framework for a firm's supply chain agility. The selected theoretical approaches are discussed in the following sections.

Resource-Based View Theory

The origins of the Resource Based View (RBV) theory can be traced to strategic management. The premise of RBV is that firms that are able to accumulate resources and capabilities that are rare, valuable, non-substitutable, and difficult to imitate, will achieve a competitive advantage over competing firms (Wernerfelt 1984; Rumelt 1984; Barney 1991). Resource rareness refers to the perceived scarcity of the resource within markets. Value is the extent to which the resources are aligned with the external environment to exploit opportunities and reduce threats. Substitutability indicates the extent to which competitors can create equivalent resources. The degree to which competitors cannot obtain or replicate the

resources, or can only do so at a significant cost disadvantage, denotes inimitability (Hoskisson et al. 1999).

According to RBV, firms seek to identify resources that will most likely make them more competitive in the market, and then employ these resources to exploit their value (Sirmon et al. 2007). Resources and capabilities are often times used interchangeably within RBV research, and, collectively refer to the tangible and intangible assets firms use to develop and implement their strategies (Ray et al. 2004). However, a distinction can be made. Resources are more accurately described as "stocks of available factors that are owned or controlled by the firm", whereas capabilities "refer to a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect the desired end" (Amit and Schoemaker 1993, p. 35). Examples of tangible resources include manufacturing plants, raw materials, logistics networks and technology (Mentzer et al. 2004). Examples of intangible resources and capabilities include proprietary knowledge, relationships, customer loyalty, corporate culture and philosophies, and supply chain competencies (Hult et al. 2002; Mentzer et al. 2004).

The possession of resources alone is not sufficient to create superior firm performance (Sirmon et al. 2007). Resources must also be effectively managed and exploited (Lippman and Rumelt 2003; Zott 2003; Fawcett et al. 2012). Through a systematic review of empirical research that used RBV as the theoretical base, Newbert (2007) found combinations of resources to be more likely to explain higher performance in firms than resources used in isolation. Combining resources that are dependent on other resources through causal relationships can create value for the firm above and beyond the value created by individual resources (Dierickx and Cool 1989; Black and Boal 1994; Newbert 2008).

Despite its explanatory power, the RBV is considered to be essentially static in nature and inadequate to explain firms' competitive advantage in changing environments (Priem and Butler 2001). One of the most influential extensions to RBV, the dynamic capabilities perspective, has been proposed to fill that gap (Teece et al. 1997). Dynamic capabilities are defined as "the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments" (Teece et al. 1997, p. 516). A few observations about Teece et al.'s conceptualization are warranted. First, the authors categorize the nature of the concept as an ability, emphasizing the essential role of strategic management. Second, they consider the desired outcome of this special capability to be integration, building, and reconfiguration of internal and external competences. By doing so, they assume an evolutionary economics perspective (Nelson and Winter 1982) and recognize the role of routines, path dependencies, and organizational learning. Third, the authors focus on a particular type of external context, namely, rapidly changing environments. Fourth, they argue that dynamic capabilities are built rather than acquired, and that their creation is embedded in organizational processes. Fifth, similar to resources and capabilities within RBV, dynamic capabilities are considered heterogeneous across firms because they result from firm-specific paths, processes, and assets. Lastly, Teece et al. explicitly suggest sustained competitive advantage to be a direct outcome of dynamic capabilities.

Since the publication of Tecee et al.'s seminal research, several somewhat different interpretations of dynamic capabilities have emerged (Table 2.4). Dynamic capabilities can take on several forms. In the context of stable industry structures, they resemble the traditional conception of routines. That is, they are complicated, detailed, analytic processes that rely

extensively on existing knowledge to yield predictable outcomes. However, within the context of high-velocity markets, dynamic capabilities are simple, experiential, unstable processes that rely on rapidly created new knowledge to produce unpredictable outcomes (Eisenhardt and Martin 2000).

In one of the most comprehensive frameworks on dynamic capabilities, Tecee (2007) evaluates capabilities by technical and evolutionary fitness (Hodgkinson and Healey 2011). Technical fitness characterizes how effectively a capability performs its function, regardless of how well the capability enables a firm to make a living. Evolutionary fitness is defined as how well the capability enables a firm to make a living (Helfat et al. 2007). In his highly referenced framework, Teece (2007) separates dynamic capabilities into three categories: (1) sensing capabilities for recognizing and dealing with opportunities and threats, (2) seizing capabilities for exploiting the sensed opportunities and fending off threats, and (3) reconfiguring capabilities for maintaining competitiveness through enhancing, combining, protecting, and modifying operational capabilities.

Sensing new opportunities is accomplished through scanning and search processes. The sensing capability is similar to the alertness dimension of agility. Seizing represents how organizations address the sensed opportunity. It is accomplished by conducting activities such as delineating the products and services and defining the most suitable business model for exploiting opportunities (Teece 2007). Seizing also refers to taking advantage of investments realized in the sensed opportunities (Helfat and Peteraf 2009). Reconfiguring allows organizations to continuously realign the operational capabilities with the seized opportunities. Reconfiguring is embedded in the notion of internally focused learning (Weerawardena and

O'Cass 2004). Internal learning describes the unlearning of existing operational capabilities and the creation of new operational capabilities.

Supply chain agility can be conceptualized as a dynamic capability for several reasons, including: it meets the criteria of being a higher-level capability (Winter 2003), it is dedicated to the modification of operating routines (Zollo and Winter 2002), it facilitates resource reconfiguration and it enables sensing and capitalizing on environmental threats and opportunities (Teece 2007). Since dynamic capabilities are hard to replicate sources of competitive advantage, supply chain agility can allow firms to achieve superior levels of firm performance (Asanuma 1989; Dyer 1996).

It is also the premise of this research that firm orientations can be considered strategic resources that can improve the competitiveness of a firm and possibly lead to improved performance. In subsequent sections of this chapter, supply chain orientation and market orientation are defined and their role within the firm explained through the lens of the RBV.

The Relational View Theory

The strategic management literature also provides another useful conceptual lens through which the sources of firms' competitive advantage can be understood. Unlike the resource-based view of the firm (RBV) which proposes that a firm's superior performance originates from its own resource-based advantages (Wernerfelt 1984; Barney 1991), the relational view (RV) theory suggests that a firm's sources of competitive advantage may extend beyond firm boundaries. Studies show that partners who are willing to make relation-specific investments and combine resources in unique ways can achieve superior levels of performance (Asanuma 1989; Dyer 1996). Idiosyncratic inter-firm linkages can be a source of competitive

advantage over firms that are unable or unwilling to form similar linkages (Dyer and Singh 1998).

Table 2.4

Definitions of Dynamic Capabilities

Author	Definition
Teece and Pisano 1994	The subset of the competences and capabilities that allow the firm to create new products and processes and respond to changing market circumstances
Teece, Pisano, and Shuen 1997	The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.
Eisenhardt and Martin 2000	The firm's processes that use resources-specifically the processes to integrate, reconfigure, gain, and release resources-to match and even create market change; dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die
Teece 2000	The ability to sense and then seize opportunities quickly and proficiently
Zollo and Winter 2002	A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness
Winter 2003	Those (capabilities) that operate to extend, modify, or create ordinary capabilities
Zahra, Sapienza, and Davidsson 2006	The abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision makers
Helfat et al. 2007	The capacity of an organization to purposefully create, extend, or modify its resource base
Teece 2007	Dynamic capabilities can be disaggregated into the capacity a) to sense and shape opportunities and threats, b) to seize opportunities, and c) to maintain competitiveness through enhancing, combining, protecting, and when necessary, reconfiguring the business enterprise's intangible and tangible assets
Salunke, Weerawardena, and McColl-Kennedy 2011	Organizational and strategic routines by which managers alter their resource base-acquire and shed resources, integrate them together, and recombine them-to generate new value-creating strategies

Four potential sources of inter-organizational competitive advantage are suggested: relation-specific assets, knowledge-sharing routines, complementary resources/capabilities, and effective governance. Relations-specific assets are considered to generate relational rents through sub-processes related to the duration of safeguards and the volume of inter-firm transactions. Knowledge-sharing routines are suggested to lead to relational rents through sub-processes related to partner-specific absorptive capacity and incentives to encourage transparency and discourage free riding. Complementary resources and capabilities are argued to facilitate relational rents through sub-processes related to the partners' ability to identify and evaluate potential complementarities, and the partners' ability to access benefits of strategic resource complementarity. Finally, effective governance is thought to generate relational rents through sub-processes related to the partners' ability to employ self-enforcement rather than third-party enforcement mechanisms and the ability to employ informal versus formal self-enforcement governance mechanisms (Dyer and Singh 1998).

Companies no longer compete against each other as autonomous entities, instead competition has shifted to supply chain against supply chain (Christopher and Towill 2001; Stank et al. 2005). This perspective finds support in the RV theory which recognizes that competitiveness does not arise from within-firm, but inter-firm sources of advantage (Dyer and Singh 1998; Mesquita et al. 2008). The RV theory supports the transition in unit of analysis from firm to supply chain, and is considered a vital extension to the RBV (Fawcett and Waller 2011). Firms may not be able to develop supply chain agility in isolation from their supply chain members. Supply chain agility accrues from the focal firm investing in specific relationships with

its supply chain members. Therefore, it is logical to consider supply chain agility a competitive advantage within the RV theory.

While offering different perspectives on sources of competitive advantage, the RV and RBV's dynamic perspective are not self exclusive. Combined, they offer stronger theoretical support for considering firm supply chain agility as a source of competitive advantage. Aside from firm-level resources, organizations can also transform extant supply chain resources into distinctive capabilities (Newbert 2007; Allred et al. 2011). Supply chain relationships are a potential source of vital complementary resources that the focal firm can access (Fawcet et al. 2007; Ketchen et al. 2007). Firm supply chain agility is a dynamic capability that results from the firm's ability to reconfigure firm-level and supply chain-level resources. The identification and evaluation of potential complementary resources and capabilities across supply chain members, the creation of knowledge-sharing routines, and the investment in supply chain relation-specific assets can contribute to the creation of firm supply chain agility. The identification of complementary resources and capabilities can help supply chain members combine their resources to more effectively respond to changes (Gligor and Holcomb 2012). Establishing knowledge-sharing routines across supply chain members is essential for a coordinated agile response (Christopher et al. 2004). Further, agility research shows that shared information between supply chain partners can only be fully leveraged through process integration, which means "collaborative working between buyers and suppliers, joint product development, and common systems" (Christopher 2000, p. 39). This is consistent with the RV theory and suggests that in order to ensure a high degree of process integration, investments in relation-specific assets might be necessary.

The Strategy-Structure-Performance Paradigm

In order to maximize their performance, organizations should strategically approach the development of their desired level of supply chain agility (Christopher et al. 2006; Goldsby et al. 2006). The strategy-structure-performance (SSP) paradigm provides a useful theoretical lens for evaluating the nature of strategic planning (Galunic and Eisenhardt 1994). According to the SSP paradigm, a firm's strategy, created in consideration of external environmental factors, drives the development of organizational structure and processes (Galbraith and Nathanson 1978; Miles and Snow 1978). Firms that have properly aligned strategy with structure are expected to perform better than competitors that lack the same degree of strategic fit (Child 1972; Miles and Snow 1978; Galbraith and Kanzanjian 1986; Hoskisson 1987; Wolf and Egelhoff 2002; Stank et al. 2005).

According to SSP, the firm's strategic orientation predicts the structure the firm will develop. Part of structure development involves firms deciding how to allocate resources to create capabilities and how sets of capabilities should be coordinated and organized (Stank et al. 2005). The two firm orientations of interest to this dissertation are firm supply chain orientation (SCO) and market orientation. Existing research has viewed both orientations from a strategic perspective (Esper et al. 2010; Taghian 2010). Strategic SCO approaches conceptualize it through an emphasis on the importance of strategic direction in managing supply chains. This perspective implies making a strategic choice to compete on the basis of supply chain capabilities (Esper et al. 2010). The strategic aspect of SCO emphasizes a systems approach to viewing the supply chain holistically rather than as constituent parts (Min and Mentzer 2004).

Market orientation is also considered a firm strategy (Taghian 2010). The two major market orientation perspectives, behavioral and cultural, consider the transformation of an organization into a market-oriented entity to take place through a process that in time will enable the strategy to become self-supporting. Two distinct routes are suggested for implementing the market orientation strategy. The behavioral school of market orientation suggests that certain conditions need to exist in order to generate the right environment for a market orientation to become possible within an organization, such as: top management's commitment to a market orientation, risk aversion of top managers, inter-departmental conflict and connectedness, centralization, reward system orientation, employees' commitment to the organization, and esprit de corps (Kohli and Jaworski 1990; Kohli et al. 1993). The cultural school states that market orientation is an organizational dominant culture that supports continuous creation of customer value (Narver and Slater 1990). The main cultural values associated with market orientation include: clarity of the value discipline and its value proposition (Webster 1994; Treacy and Wiersema 1995), leading customers not merely following them (Hamel and Prahalad 1994), considering the business as a service business (Webster 1994), and managing the business for, and in terms of, its key customers and employees (Reichheld and Sasser 1990). While distinct, both schools of thought acknowledge that market orientation is a strategy that helps the organization fulfill its fundamental responsibility: sustainable value creation for its stakeholders (Taghian 2010).

In the following sections, supply chain orientation and market orientation are formally defined, and their role in the creation of firm supply chain agility is examined through the lens

of the SSP paradigm. The SSP paradigm also provides the theoretical support for examining the relationship between firm supply chain agility and firm performance.

STRATEGIC ORIENTATIONS

An orientation is an underlying consciousness or latent philosophy that directs the nature and scope of a firm's internal and external activities (Borch 1957; Peterson 1989; Kotler 1997). Strategic orientations are seen as principles that direct and influence the activities of a firm and generate behaviors intended to ensure its viability and performance (Gatignon and Xuereb 1997; Hakala 2011). They address the long-term positioning of a firm in the competitive environment and the resource allocation priority of the firm (Lau 2011). Different strategic orientations involve distinctive investments in physical, human and financial resources (Wiklund and Shepherd 2003). A number of research articles suggest that a single orientation is inadequate and balancing several orientations enables firms to perform better (Baker and Sinkula 1999; Atuahene-Gima and Ko 2001; Bhuian et al. 2005; Grinstein 2008; Hakala 2011). The two strategic orientations examined in this dissertation are market orientation and supply chain orientation. Research suggests that both orientations are critical to the development of firm supply chain agility.

Market Orientation

The concept of market orientation plays a central role in marketing management and strategy. It focuses on creating superior customer value while pursuing profits (Slater and Narver 1994). Different researchers emphasize distinct aspects of market orientation. Kohli and

Jaworski (1990) propose that market orientation is a set of organization-wide implementing activities of the marketing concept so that a market-oriented firm practices the three pillars of the marketing concept (customer focus, coordinated marketing, and profit orientation) to satisfy customers.

Narver and Slater (1990, p.21) emphasize the behavioral aspects of the market orientation strategy, and define it as "the organizational culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers, and thus, continuous superior performance for the business". Market orientation can be conceptualized as a set of three behavioral components: customer orientation, competitor orientation, and inter-functional coordination (Narver and Slater 1990).

Customer orientation entails sufficient understanding of one's target buyers to continuously create superior value for them. It requires that a seller understands a buyer's entire value chain: current and also how it will evolve over time due to market dynamics. Two ways to create value for a buyer are suggested: one is by increasing benefits to the buyer in relation to the buyer's costs, and the second one is by decreasing the buyer's costs in relation to the buyer's benefits. A seller needs to understand not only the cost and revenue dynamics of its immediate target buyers, but also the cost and revenue dynamics experienced by the buyers' buyers from whose demand the demand in the immediate market is derived (Narver and Slater 1990). In essence, a seller must understand the economic and political constraints at all levels in the supply chain.

Competitor orientation refers to an understanding of the short-term strengths and weaknesses and long-term capabilities and strategies of both the key current and the key

potential competitors (Porter 1980; Aaker 1988). Both, customer and competitor orientations include activities associated with generation of information about buyers and competitors and its dissemination throughout the organization.

Inter-functional coordination describes the coordinated utilization of company resources in creating superior value for target customers. The collective efforts of design, production, distribution, and promotion of product offering are employed to respond to the generated and disseminated market intelligence.

Kohli and Jaworski (1990) operationalize the concept of market orientation as the organization-wide generation, dissemination, and responsiveness to market intelligence. The Kohli and Jaworski interpretation is adopted in this dissertation.

According to Kohli and Jaworski, intelligence generation is the starting point of a market orientation. Market intelligence goes beyond understanding customers' needs and preferences, and includes an analysis of how they may be affected by exogenous factors such as government regulation, technology, competitors, and other environmental forces. Environmental scanning activities and anticipation of customers' needs are included in market intelligence generation. Intelligence must be disseminated for an organization to adapt to market needs. Effective dissemination of market intelligence is important because it facilitates a shared platform for joint actions by different departments. The third element of a market orientation is responsiveness. It can be described as the action taken in response to the intelligence generated and disseminated (Kohli and Jaworski 1990). If an organization generates and disseminates intelligence, but does not act upon it, it does little good to the firm.

In essence, market oriented firms seek to understand customers' expressed and latent needs and develop superior solutions to those needs (Slater and Narver 1999). Market orientation can be viewed as a continuum, with firms exhibiting varying degrees of this propensity (Braunscheidel and Suresh 2009). The benefits of being market oriented have been widely acknowledged by a plethora of research articles empirically linking market orientation to firm performance (Narver and Slater 1990; Slater and Narver 2000; Pulendram et al. 2003; Qu and Ennew 2003; Santos-Vijande et al. 2005; Martin-Consuegra and Esteban 2007; Farrel et al. 2008; Nwokah 2008; Megicks and Warnaby 2008; Singh 2009; Liao et al. 2011).

It is the premise of this dissertation research that market orientation also facilitates the development of firm supply chain agility. In order to develop the level of supply chain agility that supports the creation of value for all echelons in the supply chain, firms have to first understand what customers want. A market oriented firm generates, disseminates and acts on customer information. This indicates that market orientation facilitates agile response through the provision of market intelligence.

Supply Chain Orientation

In order to describe the concept of supply chain orientation, it is important to first clearly define the terms supply chain and supply chain management (SCM). A supply chain can be described as "a set of three of more organizations directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer" (Mentzer et al. 2001, p. 4). Research distinguishes between supply chains as phenomena that exist, and the management of supply chains. Supply chains exist, whether managed or not managed. Mentzer et al. (2001, p. 18) define SCM as "the systemic, strategic

coordination of the traditional business functions and 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". Supply chain management consists of different terms to delineate different phenomena: a supply chain orientation within a firm, and supply chain management across firms within a supply chain (Mentzer et al. 2001). Both constructs are operationalizations of SCM philosophy. This philosophy can be described as a shared mental model of joint problem solving both inside and outside the firm and within the boundaries of a supply chain (Min et al. 2007). The SCM philosophy (1) takes a systems approach to viewing the supply chain as a whole rather than a set of fragmented parts, and to managing the total flow of goods inventory from the supplier to the ultimate customer, (2) seeks synchronization of intra-firm and inter-firm operational and strategic capabilities into a unified whole, and (3) focuses on customer value creation leading to customer satisfaction (Mentzer et al. 2001).

Successful SCM requires each firm in the supply chain to be supply chain oriented. Without SCO inside firms, it is not possible to implement SCM philosophy within the supply chain (Min et al. 2007). Thus, Mentzer et al. (2001, p. 11) define SCO as "the recognition by an organization of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain". While SCM focuses on the management of exchange flows within and across members of the supply chain, SCO emphasizes the strategic awareness and embracing of SCM within an individual supply chain firm. Supply chain orientation emerges as a necessary antecedent to effective supply chain management (Min and

Mentzer 2004). This suggests that firms possessing a SCO should approach SCM differently than firms that are less inclined to view supply chain management strategically.

Since its introduction, two different views have emerged regarding the conceptualization of SCO. The concept has been viewed from both strategic and structural perspectives. Esper et al. (2010) suggest that the successful creation of a SCO requires a high degree of fit between the organization's strategy and structure. Research on the strategic SCO conceptualizes it through an emphasis on the importance of strategic direction in managing supply chains. This perspective involves making a strategic choice to compete on the basis of supply chain capabilities (Defee and Stank 2005) and employing this strategic emphasis to drive the performance of strategic business units within the firm (Stank et al. 2005). The structural perspective of SCO emphasizes organizational artifacts that facilitate SCM. Min et al. (2007) suggest that supply chain orientation implies building and maintaining internal behavioral elements that facilitate relational elements. These authors emphasize the behavioral dimensions of trust, commitment, organizational compatibility, cooperative norms and top management support as elements of SCO. In their research, Min and Mentzer (2004) and Min et al. (2007) found empirical support for the relationship between these elements and SCO.

Anderson and Weitz (1989) argue that no benefits can be derived from a relationship unless the parties involved believe the relationship will last. The continuity of the relationship is contingent on trust, which they define as the belief that requirements will be fulfilled in the future by the other party's actions. Other researchers offer slightly different conceptualizations of trust. Ganesan defines it as a willingness to rely on a party in whom one has confidence, while Morgan and Hunt (1994) see it as confidence in the reliability and integrity of the other

party. Although definitions vary slightly, a degree of consensus exists that trust is composed of both, credibility and benevolence (Ganesan 1994; Golicic and Mentzer 2006). Credibility is one party's belief that its partner will stand by its word and deliver on promises that it agreed to and fulfill any understood or stated obligations (Dwyer and Oh 1987; Anderson and Narus 1990). Benevolence is a firm's belief that its partner is interested in the firm's welfare and will not take unexpected actions that would have a negative impact on the firm (Rempel et al. 1985; Anderson and Narus 1990; Min et al. 2007).

Commitment is the implicit or explicit pledge of relational continuity between exchange partners (Dwyer et al. 1987). A firm's commitment to a supply chain member manifests itself in the willingness to share in the risks and rewards that may be realized as a result of the relationship. Trust and commitment facilitate collaboration among members of the supply chain and are considered to be the most important relational factors of SCO (Min et al. 2007).

Cooperative norms describe the perception of the joint efforts of the relational parties to achieve mutual and individual goals while refraining from opportunistic actions (Siguaw et al. 1998). Cooperation entails alignment of interests between participating parties (Lawrence and Lorsch 1967). Yusuf et al. (2004) note that companies are being pressured to cooperate in order to succeed in the prevailing business environment. Cooperation is often difficult to reach because individuals/firms are often driven by the achievement of private benefits at the expense of collective benefits. The prisoner's dilemma is a classic example of how actors behave in order to protect their self-interest. The problem of cooperation can be resolved by aligning interests through formal mechanisms such as monitoring, sanctions (Williamson 1985), common ownership of assets (Grossman and Hart 1986), contracting (Williamson 1975), and

the potential of future interactions (Heide and Miner 1992). Informal mechanisms such as identification and embeddedness, can also be used to align interests (Granovetter 1985; Gulati 1995).

For successful SCM, members of the supply chain must also have compatible corporate culture and management techniques (Cooper et al. 1997; Lambert et al. 1998). Finally, the realization of SCM is contingent upon top management support, which includes leadership and commitment to change (Min and Mentzer 2004). Top management support is essential for developing and maintaining strong relationships with supply chain partners (Lambert et al. 1998).

Supply chain orientation can be considered a strategic firm capability (Hult 2008). A firm's SCO is reflected in the firm's culture, which makes it difficult to imitate (Mello and Stank 2005). Successful reconfiguration of resources within the supply chain requires supply chain management. Supply chain agility cannot be achieved in isolation from supply chain members (Christopher 2000). Therefore, it is the premise of the current research that SCO also facilitates the development of firm supply chain agility.

ENVIRONMENTAL UNCERTAINTY

According to classical contingency theory, the optimal organizational design does not exist. Instead firms must adapt their collaborative mechanisms to the contingencies of the external environment (Galbraith and Nathanson 1973). Environmental uncertainty has been suggested as one of the most relevant contingent factors because organizations have higher

information processing needs in uncertain environments than in more stable environments (Gupta et al. 1986). Uncertainty arises when managers perceive their business environment as unpredictable (Milliken 1987).

Environmental uncertainty has long been examined in strategic management and organization theory literature. Most research articles adopt one of the two dominant perspectives: (1) the information uncertainty approach, or (2) the resource dependence theory (Kreiser and Marino 2002). This dissertation research adopts the second perspective. The premise of the first approach is that a firm finds it impossible to acquire perfect knowledge about its business environment, and this lack of information provokes environmental uncertainty within the organization (Lawrence and Lorsch 1967; Duncan 1972; Milliken 1987). On the other hand, the basis of the resource dependence theory is that the business environment provides a number of scarce resources that the firm needs in order to survive (Pfeffer and Salancik 1978; Dess and Beard 1984; Finkelstein 1997). As a result, when firms have no control over such resources, environmental uncertainty arises in relation to the way in which these organizations must operate in the business environment. To illustrate the two perspectives, Duncan (1972) defines environmental uncertainty as the shortage of information on the events and actions taking place in the business environment and the impossibility of predicting external changes and their impact on organizational decisions. Alternatively, Dess and Beard (1984) refer to it as the rate of change and the degree of instability in the environment. The latter is also the definition of environmental uncertainty adopted for this dissertation.

Using a factor analysis of a comprehensive set of environmental variables, Dess and Beard (1984) concluded that three dimensions of the environment contribute most to uncertainty: dynamism (stability-instability, turbulence), munificence (capacity), and complexity (homogeneity-heterogeneity, concentration-dispersion). These dimensions are conceptually similar to those proposed by other researchers (Jurkovich 1974; Pfeffer and Salancik 1978; Scott 1981) and almost identical with those identified by Child (1972): illiberality, variability, and complexity.

Dynamism refers to the volatility and unpredictability of changes in the business environment (Keats and Hitt 1988). Research shows that dynamic environments can be characterized by changes in technologies, variations in customer preferences, and fluctuations in product demand and supply of materials (Wang et al. 2011). Industries with higher uncertainty in demand, for example, are more dynamic (Xue et al. 2011). Environmental munificence is the extent to which the environment can support sustained growth (Starbuck 1976) and is similar to Aldrich's (1979) concept of environmental capacity. Aldrich argues that organizations seek out environments that permit organizational growth and stability. Growth and stability can allow the organization to generate slack resources (Cyert and March 1963) which in turn create a buffer for the organization during periods of relative scarcity. In munificent environments, firms tend to adopt strategies and structures that can help them capture these growth opportunities (Xue et al. 2011). Complexity describes the number and heterogeneity of task-environment elements that a firm has to manage (Dess and Beard 1984). The larger the number of entities (e.g., competitors) a firm has to contend with, the more complex the environment.

Some conceptualizations of environmental uncertainty differ in terms of the scope of the environment. Fynes et al. (2004) define environmental uncertainty as the degree to which the firm's external environmental is characterized by the absence of a pattern, unpredictability, and unexpected change. The external environment is suggested to include factors external to the supply chain (competitors' actions, technology, and consumer tastes and preferences), whereas supply and demand risks are considered internal to the supply chain (Srinivasan et al. 2011). This interpretation is different from Wang et al.'s (2011) definition of environmental uncertainty which includes supply and demand factors. Factors outside the firm but within the firm's supply chain are considered part of the firm's environment. For the purpose of this dissertation the Wang et al. conceptualization of environmental uncertainty is adopted. There is limited need for agility in environments characterized by low levels of munificience, dynamics, and complexity (Lee 2002; Swafford et al. 2006; Sebastiao and Golicic 2008). Therefore, it is the premise of the current research that environmental uncertainty indirectly impacts the strategic development of firm supply chain agility via the firm's supply chain orientation and market orientation.

FIRM PERFORMANCE

To date, there is little empirical research on the relationship between firm supply chain agility and firm performance. Traditional performance measures can be used to describe ways in which agility creates value. For firms, a clear understanding of the performance outcomes

associated with supply chain agility is needed to guide the allocation of resources needed to develop this capability.

Performance measurement is an analysis of both efficiency and effectiveness in accomplishing a given task (Mentzer and Konrad 1991). Efficiency is considered best represented through some ratio between the normal level of inputs over the real level of outputs (Chamberlain 1968; Van der Meulen and Spijkerman 1985; Mentzer and Konrad 1991). Effectiveness refers to the ratio between the real or actual outputs and the normal or expected outputs (Katz and Kahn 1978; Sink 1985; Mentzer and Konrad 1991).

Cost Efficiency

Efficiency is a measure of how well resources are utilized (Mentzer and Konrad 1991). Cost reductions and efficiency improvements are contributors to value creation within firms (Lambert and Pohlen 2001). Langley and Holcomb (1992) suggest that efficiency implies managing resources wisely and leveraging expenses into customer value whenever possible. They refer to it as the ability to provide the desired product/service mix at a cost level that is acceptable to the customer. Halley and Guilhon (1997) offer an alternative interpretation and describe efficiency as the contribution of logistics activities to sales turnover, profitability, customer satisfaction, and employee motivation. At a supply chain level, it is the comparison of resources used for supply chain operations, against the outcome derived from the resource usage (Mentzer and Konrad 1991). Efficiency focuses on reductions to the total cost of supply chain operations needed to provide a target level of customer value (Houlihan 1987; Christopher and Peck 2004). Research recognizes efficiency as a primary objective of SCM

(Mentzer et al. 2001). For the purpose of this dissertation, *efficiency is defined as the ratio of resources utilized against the results derived, and referred to as cost efficiency.*

Customer Effectiveness

Effectiveness describes the extent to which goals are accomplished by an organization (Mentzer and Konrad 1991). Langley and Holcomb (1992) consider effectiveness measures to be whether the logistics function meets customer requirements in certain areas, such as product guarantee, in-stock availability, fulfillment time, convenience, retail service, innovation, and market standing. It assesses the extent to which customer service demands were met and whether customers were satisfied with the level of service provided (Cooper and Ellram 1993; Otto and Kotzab 2003). Research suggests that effectiveness is associated with a focus on overall revenue enhancement (Defee and Stank 2005). Providing the best customer value, given strategic goals and cost constraints, can result in revenue enhancement. Effectiveness is considered a response-oriented concept: managers identify customer demands and work to create effective solutions to meet those needs. It is a customer-centric performance goal as it allows the firm, along with its supply chain, to deliver products to end consumers in a manner that creates customer value and satisfaction (Walters 2006). *Effectiveness is defined in this dissertation as the extent to which customer-related objectives have been met, and referred to as customer effectiveness*.

The overall level of financial performance is evaluated in this dissertation by assessing the firm's performance relative to its major competitors. Specifically, return on sales, return on assets, return on investment, and profit margin are used as key financial performance indicators (Baker and Sinkula 1999; Matsuno et al. 2000; Fugate et al. 2009).

RESEARCH HYPOTHESES AND THEORETICAL MODEL

The preceding literature review provides the background for the major constructs of interest to this dissertation research and the theoretical lenses that will be used to examine them. Moreover, the review of previous research further supports the investigation of the research questions proposed in Chapter 1. The following sections explain the relationship among the constructs of interest, develop research hypotheses, and introduce the theoretical model.

Environmental Uncertainty-Strategic Orientations Link

The SSP paradigm provides theoretical support for considering environmental uncertainty as an indirect antecedent to the strategic development of firm supply chain agility. This paradigm proposes that a firm's strategy created in consideration of external environmental factors drives the development of organizational structure and processes (Galbraith and Nathanson 1978; Miles and Snow 1978; 1984). Also, best performing firms develop strategies that closely fit the requirements of their environment (Chandler 1962; Rumelt 1974). In accordance with SSP, it is the premise of this dissertation that environmental uncertainty directly and positively impacts a firm's market and supply chain orientations.

The development of a market orientation is an important strategic choice (Qu and Ennew 2008) and numerous research articles have emphasized the importance of a fit between strategy and business environment (Hambrick 1983; Mckee et al. 1989; Snow and Hrebniak 1980). In their seminal article, Kohli and Jaworski (1990) proposed that firms operating in

markets characterized by low turbulence and low competition intensity have a lower need to be market oriented because those firms only cater to a fixed set of customers with stable preferences, and the weak competition means fewer choices for customers. In contrast, if customers' expectations are less stable, firms must understand the changed customer preferences and adjust their offering to match them. Similarly, strong competition means more choices for customers and therefore firms must monitor and respond to customers' changing needs to ensure customers select their offerings over those of competitors. It is important to emphasize that Kohli and Jaworski (1990) do not suggest that a market orientation is not essential in environments characterized by low uncertainty, but rather that it is less vital. In their empirical research, Qu and Ennew (2008) provide additional evidence for the positive relationship between the business environment and market orientation. Thus, it is proposed that:

H1: There is a direct and positive relationship between a firm's degree of environmental uncertainty and its level of market orientation.

Before designing a supply chain, the nature of the demand and supply for the product must be considered (Fisher 1997). Supply stability and demand predictability for the product must guide the adoption of supply chain strategies (Christopher et al. 2006; Sebastiao and Golicic 2008) as "one size does not fit all" (Shewchuck 1998). Research has highlighted the importance of matching supply chain strategies with market conditions and product characteristics (Christopher and Towill 2002; Lee 2002). Different supply chain strategies require different approaches to the management of supply chains (Christopher et al. 2006). Considering that supply chain management is the sum of all the management actions

undertaken to realize the firm's supply chain orientation (Mentzer et al. 2001), firms that strategically approach supply chain management will consider the level of environmental uncertainty when developing a supply chain orientation. Research on nascent technology firms operating in dynamic environments also supports the contention that the primary strategic orientation for managing a supply chain should be developed in consideration of environmental characteristics (Sebastiao and Golicic 2008). For a firm to survive, a certain degree of fit between its environment and its supply chain orientation is required (Chandler 1962; Rumelt 1974). Therefore, the following hypothesis is put forth:

H2: There is a direct and positive relationship between a firm's degree of environmental uncertainty and its level of supply chain orientation.

Market Orientation-Firm Supply Chain Agility Link

The RBV also provides support for considering market orientation as an antecedent to the development of firm supply chain agility. According to RBV, firms that are able to accumulate resources and capabilities that are rare, valuable, non-substitutable, and difficult to imitate will achieve a competitive advantage over competing firms (Rumelt 1984; Wernerfelt 1984; Barney 1991). Market orientation is a rare resource (Hunt and Lambe 2000). Research indicates that market orientation, in combination with other resources (e.g., supply chain orientation), can contribute to the creation of a unique set of resources that can give rise to a positional advantage for firms (Hult and Ketchen 2001). It is the premise of this dissertation that *firm supply chain agility* is one of the unique resources resultant from combining market orientation with supply chain orientation. Market orientation is implanted in an organization through establishing a cultural system to continuously create superior value for customers.

Since a market orientation strategy is culturally-based, it is intangible and difficult to imitate, and therefore, a sustainable source of competitive advantage (Taghian 2010).

The strategy-structure-performance (SSP) paradigm also provides theoretical support for considering market orientation as an antecedent to firm supply chain agility. According to the SSP paradigm, a firm's strategy, created in consideration of external environmental factors, drives the development of organizational structure and processes (Galbraith and Nathanson 1978; Miles and Snow 1978). Market orientation is considered a firm strategy (Taghian 2010). The market orientation strategy drives the development of processes and capabilities needed to respond to customers' expressed and latent needs (Slater and Narver 1999). Supply chain agility has been recognized as a capability that firms must possess in order to provide a real time response to customers' unique and changing needs (Christopher 2000; Van Hoek et al. 2001; Yusuf et al. 2004).

The literature on supply chain agility offers additional support linking market orientation to firm supply chain agility. Before a firm can respond to changes in demand, it must first identify the changes. Christopher (2004) considers that agile supply chains are market sensitive. Part of being market sensitive is the ability to read customer demand in real time. This ability has been recognized as a necessary condition for agility by a plethora of research (Goldman et al. 1995; Sharifi and Zhang 1999; Zhang and Sharifi 2000; Lin et al. 2006; Agarwal et al. 2007; Jain et al. 2008; Li et al. 2008; 2009; Inman et al. 2011; Vinodh and Prasanna 2011; Zhang 2011; Tseng and Lin 2011; Lu and Ramamurthy 2012; Tallon and Pinsonneault 2011). In essence, market orientation implies organizational-wide generation, dissemination, and responsiveness to market intelligence (Kohli and Jaworski 1990). Therefore, we can infer that possessing a

market orientation contributes to the alertness dimension of firm supply chain agility as it facilitates the detection of changes in demand. While Braunscheidel and Suresh (2009) did not establish a direct relationship between the constructs, their research does suggest market orientation to be an antecedent to firm supply chain agility. As a result, the following hypothesis is considered:

H3: There is a direct and positive relationship between a firm's level of market orientation and its level of supply chain agility.

Supply Chain Orientation-Firm Supply Chain Agility Link

Supply chain orientation is a strategic resource that is rare, valuable, non-substitutable, and difficult to imitate (Mentzer et al. 2001; Mello and Stank 2005). Therefore, according to the RBV, firms with a supply chain orientation can achieve a competitive advantage over competing firms (Rumelt 1984; Wernerfelt 1984; Barney 1991). The cultural aspect of SCO makes it difficult to imitate and a sustainable source of competitive advantage. Supply chain orientation implies an understanding of the value of relationships with other supply chain members (Min et al. 2007). It is considered a necessary firm philosophy for the successful coordination and management of the supply chain (Min et al. 2001). Agility literature recognizes that firms seeking to achieve supply chain agility must actively manage their supply chains (Christopher 2000). As a result, within the RBV framework, firm supply chain agility can be considered one of the competitive advantages that results from having a supply chain orientation.

Supply chain research distinguishes between the strategic and structural aspects of SCO (Esper et al. 2010). The SCO strategy emphasizes a systems approach to viewing the supply chain holistically rather than as constituent parts; it seeks to integrate, synchronize and

converge intra-firm and inter-firm operational and strategic capabilities (Min et al. 2004). Within the strategy-structure-performance paradigm, the strategic aspect of SCO is considered to drive the development of organizational structure and processes (Galbraith and Nathanson 1978; Miles and Snow 1978). Part of structural development for firms is to determine how to allocate resources to create capabilities and how sets of capabilities should be coordinated and organized (Stank et al. 2005). Therefore, the SSP paradigm provides additional theoretical support for considering SCO an antecedent to the development of the firm supply chain agility capability.

Firms cannot develop supply chain agility in isolation from their supply chain members. Members of the supply chain must be capable of rapidly aligning their collective capabilities to respond to changes in market and customer demand (Gligor and Holcomb 2012). The key to providing an agile response is inter-firm cooperation (Goldman and Nagel 1993). Supply chain members must be linked together as a network (Christopher 2000). Firms that can better structure, coordinate, and manage relationships with their partners will achieve a higher level of agility (Lin et al. 2006; Jain et al. 2008). Supply chain orientation is a necessary antecedent to effective supply chain management (Min and Mentzer 2004; Min et al. 2007), and supply chain management is a *sine qua non* condition for developing supply chain agility (Ketchen and Hult 2007; Li et al. 2008; 2009). As a result, the following hypothesis is proposed:

H4: There is a direct and positive relationship between a firm's level of supply chain orientation and its level of supply chain agility.

Market Orientation-Supply Chain Orientation Link

Although it is not the focus of this dissertation the relationship between market orientation and supply chain orientation is investigated to enhance the explanatory power of the proposed theoretical model. Research indicates that organizational learning, an intricate part of MO, is accomplished through external partners, such as suppliers, distributors, and customers (Slater and Narver 1995). Within such alliances, partners seek to discover and acquire knowledge not available to competitors (Lei et al. 1997). In fact, alliances are an important means through which firms acquire new capabilities (Mowery et al. 1996). This suggests that MO cannot be isolated from relationships with suppliers and customers (Webster 1992) as it drives the development of a systems approach (SCO) within the firm (Min et al. 2007).

In addition to customers, markets also include members of the supply chain along with other exogenous factors that impact customer needs and preferences (Kohli and Jaworski 1990). As such, market-oriented firms must understand their consumers' behavior and their supply chain members' as well (Min et al. 2007). Market-oriented firms should be motivated to be supply chain oriented to access information from supply chain partners (Min et al. 2007). MO was also found to impact the other partners' trust, commitment and cooperative norms (Siguaw et al. 1998), which are conceptualized by Min and Mentzer (2004) as elements of SCO. Market oriented firms possess a knowledge base that facilitates the recognition of the systemic, strategic implications of managing the various flows in a supply chain (Min et al. 2007). Further, Min et al. (2007) provided empirical support that MO directly and positively impacts firm SCO. Thus, it is proposed that:

H5: There is a direct and positive relationship between a firm's level of market orientation and its level of supply chain orientation.

Firm Supply Chain Agility-Firm Performance Link

The dynamic capability perspective of the RBV indicates that capabilities need to evolve and be recreated progressively top allow firms to achieve competitive advantages over time (Diericks and Cool 1991; Teece et al.1997). Dynamic capabilities can be used to "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al. 1997, p. 516). Supply chain agility has been shown to be a higher-level capability that is dedicated to the modification of operating routines. It facilitates resource reconfiguration and it enables sensing and capitalizing on environmental threats and opportunities (Jain et al. 2008; Li et al. 2009; Gligor and Holcomb 2012). As a result, it can be considered a strategic dynamic capability, and can positively impact firm performance in a sustainable manner.

The SSP paradigm also supports the link between firm supply chain agility and organizational performance. It suggests that a firm's supply chain agility developed in consideration of the firm's strategy (e.g., combination of market orientation strategy and supply chain orientation strategy) can lead to organizational performance superior to that of competitors who lack the same degree of fit (Miles and Snow 1984). While a firm's internal SCO and MO can guide the development of the firm's supply chain agility, this capability cannot be created in isolation from the firm's supply chain members. Since part of strategically creating supply chain agility is the development of idiosyncratic linkages with supply chain partners,

supply chain agility can also be considered a source of competitive advantage within the RV framework (Dyer and Singh 1998; Mesquita et al. 2008).

Research has consistently associated agility with effective supply chain management (Christopher 2000; Ketchen and Hult 2007; Li et al. 2008). Agility has been referred to as an effective response to change (Mason-Jones and Towill 1999; Dove 2005; Holsapple and Jones 2005), and as effective, flexible accommodations of customer demand (Christopher 2000). In fact, Ketchen and Hult (2007) suggest that agility is a criterion for gauging a supply chain's effectiveness. However, to date, no research has empirically tested the relationship between firm supply chain agility and firm effectiveness. To address this limitation, the following hypothesis is considered:

H6: There is a direct and positive relationship between a firm's level of supply chain agility and the firm's customer effectiveness.

Agility has been traditionally linked to customer effectiveness and considered the opposite of lean, which has been linked to cost efficiencies (Christopher 2000; Goldsby et al. 2006). Supply chain researchers characterize lean management as concerning the minimization of waste and, therefore, liken this to a strategy focused on efficiency (Christopher and Towill 2002; Randall et al. 2003; Christopher et al. 2006; Sebatiao and Golicic 2008). These researchers suggest that agility is about availability, flexibility, and the ability to react quickly to changes, and that it has less to do with efficiencies. However, supply chain research provides no empirical evidence to indicate that agile supply chains cannot be efficient as well.

There are divergent perspectives across supply chain researchers regarding the relationship between agility and efficiency. Lee (2004) argues that most supply chains cope with

sudden and unexpected changes in demand and supply by playing speed against costs, but agile ones respond quickly and cost efficiently. Therefore, he proposes that agile supply chains are not only effective, but efficient as well. Tseng and Lin (2011) suggest that embracing agile strategies has several benefits for companies, including quick and efficient reaction to changing market requests. These authors recognize the possibility that agile entities can also be efficient. Manufacturing (Fliedner and Vokurka 1997; Zhang and Sharifi 2000; Gunasekaran and Yusuf 2002) and sports science (Miller et al. 2006) research also recognizes the efficiency aspect of agility. Therefore, in order to empirically examine the relationship between firm supply chain agility and efficiency, the following hypothesis is put forth:

H7: There is a direct and positive relationship between a firm's level of supply chain agility and the firm's cost efficiency.

Finally, it is the premise of this research that a firm's cost efficiency and customer effectiveness will positively impact the firm's financial performance. This is consistent with extant literature on performance measurement (Mentzer and Konrad 1991; Brewer and Speh 2000; Lambert and Pohlen 2001). Research suggests that as processes become more efficient and effective, financial performance improves as well (Lambert and Pohlen 2001). For example, Fugate et al. (2009) empirically established the link between logistics operations efficiency and effectiveness and organizational financial performance. As a result, the following hypotheses are suggested:

H8: There is a direct and positive relationship between a firm's customer effectiveness and its financial performance.

H9: There is a direct and positive relationship between a firm's cost efficiency and its financial performance.

Theoretical Model

A theoretical model, shown in Figure 2.2, displays the hypothesized relationships among the constructs of environmental uncertainty, market orientation, supply chain orientation, firm supply chain agility, and the dimensions of firm performance. A summary of these hypotheses is shown in Table 2.5.

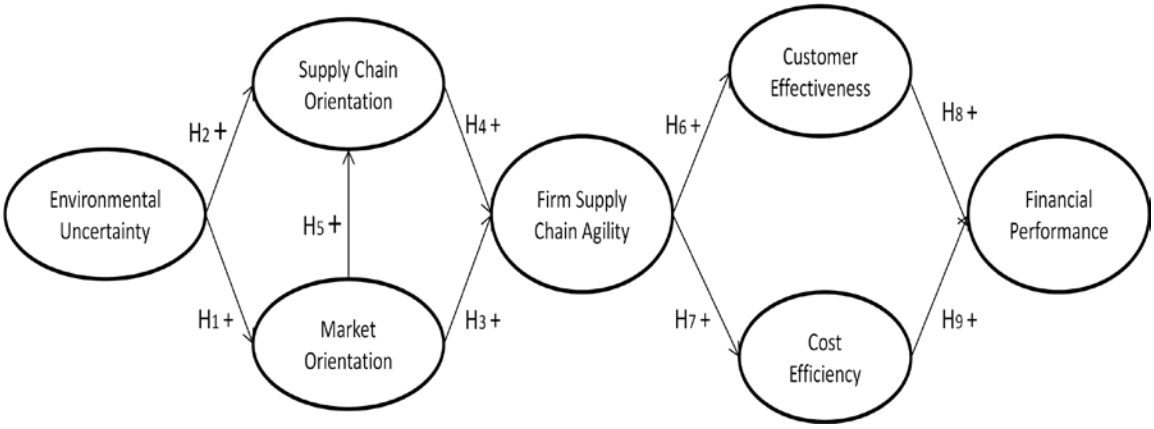

Figure 2.2

Theoretical Model of Firm Supply Chain Agility

CHAPTER SUMMARY

This chapter laid out the theoretical background for the empirical research that is planned to be executed in this dissertation. Specifically, (1) the various dimensions of the concept of agility were identified, (2) a clear distinction between agility and the concepts of

Table 2.5

Summary of Hypotheses

Hypothesis	Description
H1	There is a direct and positive relationship between a firm's degree of environmental uncertainty and its level of market orientation.
H2	There is a direct and positive relationship between a firm's degree of environmental uncertainty and its level of supply chain orientation.
H3	There is a direct and positive relationship between a firm's level of market orientation and its level of supply chain agility.
H4	There is a direct and positive relationship between a firm's level of supply chain orientation and its level of supply chain agility.
H5	There is a direct and positive relationship between a firm's level of market orientation and its level of supply chain orientation.
H6	There is a direct and positive relationship between a firm's level of supply chain agility and the firm's customer effectiveness.
H7	There is a direct and positive relationship between a firm's level of supply chain agility and the firm's cost efficiency.
H8	There is a direct and positive relationship between a firm's customer effectiveness and its financial performance.
H9	There is a direct and positive relationship between a firm's cost efficiency and its financial performance.

flexibility, responsiveness, resilience, and adaptability was offered, (3) the theoretical lenses used to investigate the phenomena of interest were described (the Resource Based View theory, the Strategy-Structure-Performance paradigm, and the Relational View theory), (3) the strategic antecedents of firm supply chain agility were identified (Environmental Uncertainty, Supply Chain Orientation, Market Orientation), and (4) the dimensions of firm performance hypothesized to be impacted by firm supply chain agility were introduced (Customer Effectiveness, Cost Efficiency, and Financial Performance). Next, Chapter 3 lays out the methodology that will be used to address the research questions and the relationships hypothesized in the theoretical model.

CHAPTER 3-METHODOLOGY

INTRODUCTION

Chapter 3 presents details of the procedures employed to conduct the empirical research for this dissertation. The research design is intended to connect the broader assumptions of the research to its detailed methods of data collection, analysis, and interpretation (Creswell 2009). The research plan and structure are devised to obtain answers to the research questions of interest to the dissertation (Easterby-Smith et al. 1991; Kerlinger and Lee 2000). Furthermore, it provides the opportunity for building, revising and directing the overall research (Mills and Huberman 1984). The choice of an appropriate methodology is influenced by several factors: the format of the research question, the nature of the phenomenon under study, the extent of control required over behavioral events in the research context, and the researcher's philosophical stance (Frankel et al. 2005). For this reason, the dissertation employs a quantitative research design using a survey methodology. The conceptual model of firm supply chain agility is analyzed using structural equation modeling (SEM).

This chapter provides the details for testing the hypotheses presented in the previous chapter. The first two sections introduce SEM and the quantitative research design. This is followed by the details of the sampling technique and of the scale development and survey design. Next, the chapter presents the theoretical and operational definitions of the constructs in the model and an overview of the procedures employed to mitigate potential common method bias. The final sections include a discussion of the pretest and final test.

QUANTITATIVE RESEARCH OVERVIEW

Structural Equation Modeling

Structural equation modeling (SEM) is the main statistical analysis tool used to purify the measurement items for each of the variables shown in Figure 2.2 (Chapter 2) and to test the hypotheses shown in Table 2.5 (Chapter 2). This statistical technique allows the testing of construct validity (i.e., unidimensionality, reliability, convergent validity, discriminant validity and predictive validity) within a single research study (Garver and Mentzer 1999). It combines a measurement model (confirmatory factor analysis) with a structural model (regression or path analysis) into a simultaneous statistical test. A measurement model seeks to evaluate how well the observed indicators serve as a measurement instrument for the latent variables. Therefore, the measurement model within SEM can serve as a useful tool to assess construct validity (Garver and Mentzer 1999).

Structural equation modeling presents a number of distinct advantages over alternative statistical approaches. To illustrate, SEM accounts for measurement error in latent variables when estimating path relationships between such variables. The technique is also ideal for testing and comparing rival theoretical models (Medsker et al. 1994). Unlike multiple regression analysis, it also allows the modeling of complex structures including mediating variables. The main strength of SEM is its ability to analyze multiple relationships simultaneously. However, it is important to emphasize that the use of SEM requires larger sample sizes as compared to alternative statistical techniques (i.e., multiple regression analysis). Therefore, the benefits of using SEM can only be gained if sufficient data observations can be collected.

The theoretical path model developed in this research identifies one exogenous (independent) variable and six endogenous (dependent) variables. The endogenous variable is environmental uncertainty. The six endogenous variables are supply chain orientation, market orientation, firm supply chain agility, customer effectiveness, cost efficiency, and financial performance. The nomological network of all exogenous and endogenous variables is shown by the relationships among the seven variables, represented by the directional arrows in the structural equation model shown in Figure 3.1.

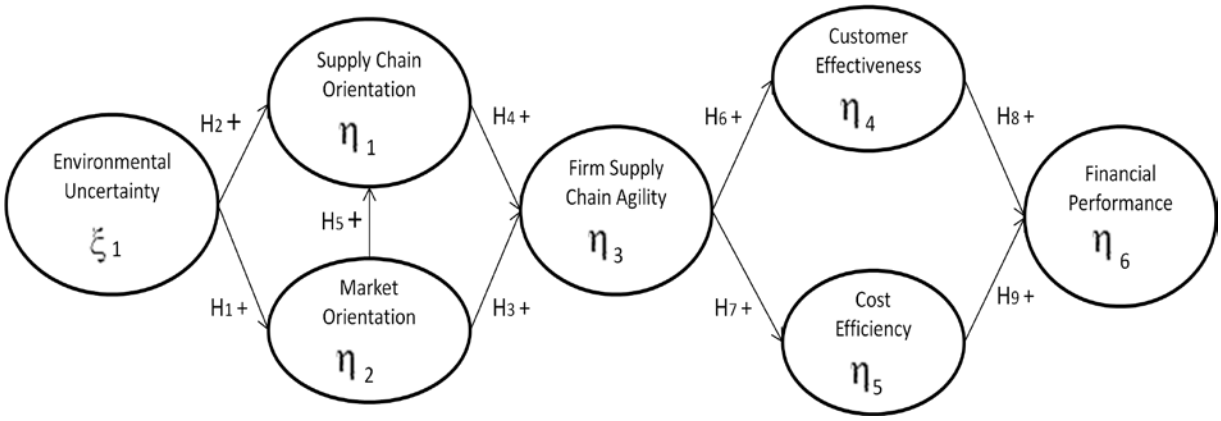

Figure 3.1

Structural Equation Model of Firm Supply Chain Agility

Quantitative Research Design

Data for this dissertation was gathered using a non-experimental survey methodology. Some of the advantages of survey research include: (1) a great deal of information can be obtained from a large population, (2) relatively economical, (3) high accuracy when appropriate sampling procedures are used, (4) allows for validity checks (Kerlinger and Lee 2000). Specifically, this research employed an internet survey to collect the necessary data for model

and hypothesis testing. Internet surveys are used extensively in research due to their ease of use, response flexibility, confidentiality and relatively low-cost (Sheehan and Hoy 1997). The web-based survey approach is appropriate for this dissertation because the population of interest is businesses, and coverage issues are not present due to high rates of computer use and the large sample size (Dillman 2000). As compared to mail survey methods, internet surveys offer easier access to respondents, shorter time for implementation, they allow for dynamic interaction between the respondent and the questionnaire, and they are more efficient and more adaptable (Dillman 2000).

Sampling

This dissertation is interested in how organizations manage their supply chains to facilitate an agile response to changes, opportunities and threats in their respective environment. Therefore, the preferred target respondents were senior-level managers with knowledge of supply-chain processes and activities, and direct involvement in operational and strategic decision-making. The unit of analysis for this dissertation research is the firm. As such, the survey focuses on the respondents' perception of their firm's supply chain related behaviors and the performance of the organization as a whole. Each variable of interest was assessed by measuring and analyzing the respondents' perceptual evaluation, except for the financial performance variable which was also evaluated using secondary data.

Potential respondents were identified from two sources. The first source of potential participants was a database of supply chain managers belonging to a large public university's supply chain management program. The database contained critical contact information for more than 3,000 managers (name, phone number, e-mail and title) from U.S.-based companies

in a diverse set of industries. Companies represented in the database were members of Supply Chain Management Forum organized by the program. The list was examined for firms and individuals that did not represent the desired unit of analysis (i.e., the firm). Only organizations and managers that met the desired criteria were retained. A sample of 285 potential respondents was selected. Participants with diverse backgrounds were targeted in order to help establish a higher level of external validity (Cook and Campbell 1979). In order to increase response rate, participants were offered an executive summary of the research findings and entered into a raffle for the chance to win $100.

The second source of potential participants was the panel members of SurveyMonkey, a large third party marketing firm that specializes in survey data collection. SurveyMonkey was contacted and provided the desired sampling criteria and sample size. Based on the required respondent attributes, 1,135 senior-level managers of diverse backgrounds, with knowledge of supply-chain processes and activities, and direct involvement in operational and strategic decision-making were prequalified to participate in the study. While participants were not provided any direct financial incentives, SurveyMonkey pledged to donate $.50 to the charity of the respondents' choice, and enter the respondents into a raffle for the chance to win $100.

Scale Development and Survey Design

Scale development followed procedures and guidelines recommended by Churchill (1979), DeVellis (1991), Mentzer and Flint (1997), and Garver and Mentzer (1999). The first-order constructs and each of the dimensions of the second-order constructs in the theoretical model are measured by multi-item scales to increase reliability, decrease measurement error, ensure greater variability among the survey participants, and improve validity (Churchill 1979).

Each construct is operationalized using at least three items to effectively measure and analyze it using SEM (Anderson and Gerbing 1982). The goal of developing survey items was to ensure that the questions are easy to understand and are not vague, ambiguous, or difficult to answer (Dillman 2000). The questions are specific enough to communicate uniform meaning to all the respondents, not lengthy and not biased (Converse and Presser 1986). Closed-ended questions were used in the survey because this dissertation's research is confirmatory in nature (Converse and Presser 1986). In order to avoid scale proliferation, when possible existing scales were consulted (Bruner 2003).

Once the survey items were determined, the procedures suggested by Dillman (2000) for survey design were employed. The objective of survey design was to increase response rate and reduce measurement error. All variables of interest were estimated through respondents' perceptual evaluation on a seven-point Likert scale: the response categories for each item were anchored by 1 (strongly disagree) and 7 (strongly agree).

Construct Measurement

In order to test the hypothesized relationships among the constructs in the theoretical model, the constructs must be operationalized (Dillman 2000). The constructs of interest were defined using the literature reviewed in Chapter 2. Table 3.1 summarizes the theoretical and operational definitions of the main constructs in the model.

Firm supply chain agility is considered a second-order formative construct, in that it is formed by an "index" represented by five first-order dimensions. The first order factors used to measure firm supply chain agility are alertness, accessibility, decisiveness, swiftness and flexibility. The specific measurement items were developed in this dissertation, except

Table 3.1

Theoretical and Operational Definitions of Constructs

Construct	Theoretical Definition	Operational Definition
Supply Chain Orientation	The recognition by a firm of the systemic and strategic implications of the tactical activities involved in managing the various flows of the supply chain.	The degree to which a firm exhibits the following characteristics toward other supply chain members: trust, commitment, cooperative norms, organizational compatibility among supply chain members, in addition to top management support.
Market Orientation	A set of organization-wide implementing activities of the marketing concept so that a market-oriented firm practices the three pillars of the marketing concept (customer focus, coordinated marketing, and profit orientation) to satisfy customers.	The degree to which the organization generates, disseminates, and responds to market intelligence.
Environmental Uncertainty	The rate of change and the degree of instability in the environment.	The degree to which the firm experiences changes in demand, supply, and technology
Firm Supply Chain Agility	The firm's ability to quickly adjust tactics and operations within its supply chain to respond or adapt to changes, opportunities or threats in its environment.	The degree to which the firm can quickly detect changes, opportunities and threats (alertness), quickly access relevant data (accessibility), quickly make decisions on how to act (decisiveness), quickly implement decisions (swiftness) and modify its range of supply chain tactics and operations to the extent needed to implement its strategy (flexibility).

Table 3.1 Continued

Construct	Theoretical Definition	Operational Definition
Customer Effectiveness	The extent to which customer-related objectives have been met	The degree to which the firm met its goals in the previous fiscal year with respect to its: ability to handle customer emergencies, ability to handle nonstandard orders to meet special needs, ability to provide customers real-time information about their order, stock availability, order fulfillment, order-to-delivery cycle time, order-to-delivery cycle time consistency, on-time deliveries and customer complaints
Cost Efficiency	The ratio of resources utilized against the results derived.	How well did the firm perform relative to its major competitor in the previous fiscal year with respect to each of the following criteria: distribution costs, manufacturing costs, inventory costs, marketing costs, supply chain costs as a percent of revenue
Financial Performance	The overall level of organizational financial performance.	How well did the firm perform relative to its major competitor in the previous fiscal year with respect to each of the following criteria: return on sales (ROS), return on assets (ROA), return on investments (ROI), profit margin

for two items intended to measure alertness which were adapted from Li et al. (2009), and four items intended to measure flexibility which were adapted from Tachizawa and Gimenez (2010). These items are presented in Table 3.2 and were further revised during the pretesting stages (Tables 3.9 and 3.10). While theoretical considerations guided the initial operationalization of the construct, post-hoc analysis helps determine whether the construct is formative or

reflective. Three empirical criteria help distinguish formative models from reflective ones (Coltman et al. 2008). The first empirical consideration pertains to item intercorrelation. In reflective models items should have high positive intercorrelations, while in formative models items can have any pattern of intercorrelation but should possess the same directional relationship (Cronbach 1951; Nunnally and Bernstein 1994; Churchill 1979; Diamantopoulos and Siguaw 2006). The second empirical criterion refers to the item relationships with construct antecedents and consequences. In reflective models items should have similar sign and significance of relationships with the antecedents/consequences as the construct, while in formative models items may not have similar significance of relationships with the antecedents/consequences as the construct (Bollen and Lennox 1991; Diamantopoulos and Winklhofer 2001; Diamantopoulos and Siguaw 2006). The third empirical consideration refers to measurement error and collinearity. In reflective models error terms in items can be identified, while in formative models error terms cannot be identified if the formative measurement model is estimated in isolation (Bollen and Ting 2000; Diamantopoulos 2006). Collectively, these three criteria were applied in the post-hoc analysis to determine if the initial theoretical operationalization of the supply chain agility construct was appropriate.

Market orientation is operationalized as a second-order construct, and the items used to measure it as indirect reflective measures (Edwards and Bagozzi 2000) of both the second and first order factors associated with it (Gerbing and Anderson 1988). Market orientation is measured using intelligence generation, intelligence dissemination and responsiveness as first order factors. These items were adapted from Matsuno and Mentzer (2000) and Min et al. 2007 and are presented in Table 3.3.

Table 3.2

Firm Supply Chain Agility Pretest Survey Items

Firm Supply Chain Agility: Alertness	Strongly Disagree			Neutral			Strongly Agree
Please indicate your level of agreement with the following statements:							
My firm can rapidly detect **changes** in its environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
My firm can rapidly detect **opportunities** in its environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
My firm can rapidly detect **threats** in its environment. (Newly Developed)	1	2	3	4	5	6	7
My firm is quicker to detect **changes** in its environment than its main competitors. (Newly Developed)	1	2	3	4	5	6	7
My firm is quicker to detect **opportunities** in its environment than its main competitors**.** (Newly Developed)	1	2	3	4	5	6	7
My firm is quicker to detect **threats** in its environment than its main competitors. (Newly Developed)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Accessibility	Strongly Disagree			Neutral			Strongly Agree
When it identifies a **change** in its environment, my firm can promptly access the information it needs to decide how to deal with the **change**. (Newly Developed)	1	2	3	4	5	6	7
When it identifies an **opportunity** in its environment, my firm can promptly access the information it needs to decide how to deal with the **opportunity**. (Newly Developed)	1	2	3	4	5	6	7
When it identifies a **threat** in its environment, my firm can promptly access the information it needs to decide how to deal with the **threat**. (Newly Developed)	1	2	3	4	5	6	7
Our **suppliers** are quick to share relevant information with us. (Newly Developed)	1	2	3	4	5	6	7
Our **customers** are quick to share relevant information with us. (Newly Developed)	1	2	3	4	5	6	7
Our **suppliers** are always fast to provide us the information we request. (Newly Developed)	1	2	3	4	5	6	7
Our **customers** are always fast to provide us the information we request. (Newly Developed)	1	2	3	4	5	6	7

Table 3.2 Continued

Firm Supply Chain Agility: Decisiveness	Strongly Disagree			Neutral			Strongly Agree
When it has relevant information about a **change** in its environment my firm can rapidly decide how to deal with the **change**. (Newly Developed)	1	2	3	4	5	6	7
When it has relevant information about an **opportunity** in its environment my firm can rapidly decide how to deal with the **opportunity**. (Newly Developed)	1	2	3	4	5	6	7
When it has relevant information about a **threat** in its environment my firm can rapidly decide how to deal with the **threat**. (Newly Developed)	1	2	3	4	5	6	7
My firm has processes in place that allow for decision-making. (Newly Developed)	1	2	3	4	5	6	7
Our supply chain managers are empowered to make quick decisions within their area of expertise. (Newly Developed)	1	2	3	4	5	6	7
As compared to our competitors, my firm is faster at making decisions regarding supply chain **operations**. (Newly Developed)	1	2	3	4	5	6	7
As compared to our competitors, my firm is faster at making decisions regarding supply chain **tactics**. (Newly Developed)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Swiftness	Strongly Disagree			Neutral			Strongly Agree
When it makes decisions regarding a change in its supply chain **operations** my firm can quickly implement it. (Newly Developed)	1	2	3	4	5	6	7
When it makes decisions regarding a change in its supply chain **tactics** my firm can quickly implement it. (Newly Developed)	1	2	3	4	5	6	7
My firm can promptly reconfigure supply chain resources to respond to **changes** in the environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
My firm can promptly reconfigure supply chain resources to respond to **opportunities** in the environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7

Table 3.2 Continued

Firm Supply Chain Agility: Swiftness	Strongly Disagree			Neutral			Strongly Agree
My firm can promptly reconfigure supply chain resources to respond to **threats** in the environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
As compared to our competitors, my firm is quicker at implementing supply chain changes/decisions.	1	2	3	4	5	6	7

Firm Supply Chain Agility: Flexibility	Strongly Disagree			Neutral			Strongly Agree
When needed, we can adjust our supply chain **operations** to the extent necessary to execute our strategy. (Newly Developed)	1	2	3	4	5	6	7
When needed, we can adjust our supply chain **tactics** to the extent necessary to execute our strategy. (Newly Developed)	1	2	3	4	5	6	7
My firm's suppliers can quickly meet an increase in order-size. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
My firm's suppliers can quickly adjust the specification of orders. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
My firm's suppliers can quickly adjust/expedite their delivery lead time. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
As compared to our competitors we have a wider range of adjustments we can make to our supply chain **operations**.(Newly Developed)	1	2	3	4	5	6	7
As compared to our competitors we have a wider range of adjustments we can make to our supply chain **tactics**.(Newly Developed)	1	2	3	4	5	6	7

Firm Supply Chain Agility-Reflective Measures (Developed in this dissertation)	Strongly Disagree			Neutral			Strongly Agree
My company quickly reconfigures supply chain operations to address **changes** in the environment. (Newly Developed)	1	2	3	4	5	6	7
My firm rapidly adjusts supply chain operations to respond to **opportunities** in the environment. (Newly Developed)	1	2	3	4	5	6	7
My firm swiftly alters supply chain operations to react to **threats** in the environment. (Newly Developed)	1	2	3	4	5	6	7

Supply chain orientation is operationalized as a first-order construct using twelve items. This builds on the initial operationalization of the construct which considers trust, commitment, cooperative norms, organizational compatibility, and top management support as some of the dimensions of supply chain orientation. Specifically, seven items were adapted from Min et al. (2007) and six items were newly developed (Table 3.4).

Table 3.3

Market Orientation Survey Items

Market Orientation-Intelligence Generation (Adapted from: Matsuno and Mentzer 2000 and Min et al. 2007)	Strongly Disagree			Neutral			Strongly Agree
We survey end users at least once a year to assess the quality of our products and services.	1	2	3	4	5	6	7
In our business unit, intelligence on our competitors is generated independently by several departments.	1	2	3	4	5	6	7
We periodically review the likely effect of changes in our business environment (e.g., regulation) on customers.	1	2	3	4	5	6	7
In this business unit, we frequently collect and evaluate general macro economic information (e.g., interest rate, exchange rate, GDP, industry growth rate, inflation rate).	1	2	3	4	5	6	7
In this business unit, we collect and evaluate information concerning general social trends (e.g., environmental consciousness, emerging lifestyles) that might affect our business.	1	2	3	4	5	6	7
In this business unit, we spend time with our suppliers to learn more about various aspects of their business (e.g., manufacturing process, industry practices, clientele).	1	2	3	4	5	6	7
Market Orientation-Intelligence Dissemination (Adapted from: Matsuno and Mentzer 2000 and Min et al. 2007)	Strongly Disagree			Neutral			Strongly Agree
Marketing personnel in our business unit spend time discussing customers' future needs with other functional departments.	1	2	3	4	5	6	7

Table 3.3 Continued

Market Orientation-Intelligence Dissemination (Adapted from: Matsuno and Mentzer 2000 and Min et al. 2007)	Strongly Disagree			Neutral			Strongly Agree
Our business unit periodically circulates documents (e.g., reports, newsletters) that provide information on our customers.	1	2	3	4	5	6	7
We have cross-functional meetings very often to discuss market trends and developments (e.g., customers, competition, suppliers).	1	2	3	4	5	6	7
Technical people in this business unit spend a lot of time-sharing information about technology for new products with other departments.	1	2	3	4	5	6	7
Market information spreads quickly through all levels in this business unit.	1	2	3	4	5	6	7
Market Orientation-Response to Intelligence (Adapted from: Matsuno and Mentzer 2000 and Min et al. 2007)	Strongly Disagree			Neutral			Strongly Agree
For one reason or another, we tend to ignore changes in our customers' product or service needs. (R)	1	2	3	4	5	6	7
The product lines we sell depend more on internal politics than real market needs. (R)							
We are slow to start business with new suppliers even though we think they are better than existing ones. (R)	1	2	3	4	5	6	7
If a major competitor were to launch an intensive campaign targeted at our customers, we would implement a response immediately.	1	2	3	4	5	6	7
Even if we came up with a great marketing plan, we probably would not be able to implement it in a timely fashion. (R)	1	2	3	4	5	6	7
We tend to take longer than our competitors to respond to a change in regulatory policy. (R)	1	2	3	4	5	6	7

Environmental uncertainty is considered a first-order construct. It is represented by six items adapted from Chen and Paulraj (2004), Liang et al. (2011) and Wang et al. (2011) (Table 3.5). The performance-related variables are also measured as first-order constructs. Customer

Table 3.4
Supply Chain Orientation Survey Items

Supply Chain Orientation	Strongly Disagree			Neutral			Strongly Agree
Our objectives are consistent with those of our suppliers. (Adapted from Min et al. 2007)	1	2	3	4	5	6	7
Our organization places a high priority on maintaining relationships with our key supply chain members. (Adapted from Min et al. 2007)	1	2	3	4	5	6	7
We trust our key supply chain members. (Adapted from Min et al. 2007)	1	2	3	4	5	6	7
We believe our supply chain members must work together to be successful. (Adapted from Min et al. 2007)	1	2	3	4	5	6	7
Our top managers reinforce the need for sharing valuable information with our supply chain members. (Adapted from Min et al. 2007)	1	2	3	4	5	6	7
The culture of our company is similar to the culture of our key supply chain partners. (Adapted from Min et al. 2007)	1	2	3	4	5	6	7
We view our supply chain as a value added piece of our business. (Adapted from Min et al. 2007)	1	2	3	4	5	6	7
We view our supply chain holistically rather than as constituent parts. (Newly Developed)	1	2	3	4	5	6	7
Our organization recognizes the strategic importance of managing its supply chain. (Newly Developed)	1	2	3	4	5	6	7
Our organization recognizes the strategic importance of coordinating business functions *within our firm*. (Newly Developed)	1	2	3	4	5	6	7
Our organization recognizes the strategic importance of coordinating business functions *across firms* within the supply chain. (Newly Developed)	1	2	3	4	5	6	7
Our organization recognizes the strategic importance of integrating *inter-firm processes.* (Newly Developed)	1	2	3	4	5	6	7
Our organization recognizes the strategic importance of integrating *intra-firm processes.* (Newly Developed)	1	2	3	4	5	6	7

effectiveness and cost efficiency are represented by nine items each, while financial performance is represented by four items. The performance-related measurement items are adapted from Beamon (1999), Min et al. (2007) and Fugate et al. (2009) (Table 3.6). Figure 3.2 represents the theoretical model with the formative and reflective scales added for the two second-order model constructs.

In order to understand differences across various business settings, a number of demographic-type questions were also included in the survey (Table 3.7). These items were adapted from Gligor and Holcomb (2012).

Table 3.5

Environmental Uncertainty Survey Items

Environmental Uncertainty	Strongly Disagree			Neutral			Strongly Agree
As compared to other industries, our industry has a higher capacity for growth. (Adapted from Liang et al. 2010)	1	2	3	4	5	6	7
Our industry is more complex to operate in as compared to other industries. (Adapted from Liang et al. 2010)	1	2	3	4	5	6	7
Our customers regularly ask for new products and services. (Adapted from Wang et al. 2011)	1	2	3	4	5	6	7
Competition is ever changing in our market. (Adapted from Wang et al. 2011)	1	2	3	4	5	6	7
The technology in our industry is changing rapidly. (Adapted from Chen and Paulraj 2004)	1	2	3	4	5	6	7
Our supply requirements vary drastically from week to week. (Adapted from Chen and Paulraj 2004)	1	2	3	4	5	6	7

Table 3.6

Organizational Performance Survey Items

Customer Effectiveness (Adapted from: Min et al. 2007; Fugate et al. 2009; Beamon 1999)	Fell Below Our Goals			Met Our Goal			Exceeded Our Goals
For the following items, please indicate the degree to which you business unit's goals were met over the last year:							
Ability to handle customer emergencies.	1	2	3	4	5	6	7
Ability to handle nonstandard orders to meet special needs.	1	2	3	4	5	6	7
Ability to provide customers real-time information about their order.	1	2	3	4	5	6	7
Stock availability.	1	2	3	4	5	6	7
Order fulfillment.	1	2	3	4	5	6	7
Order-to-delivery cycle time.	1	2	3	4	5	6	7
Order-to-delivery cycle time consistency.	1	2	3	4	5	6	7
On-time deliveries.	1	2	3	4	5	6	7
Customer complaints.	1	2	3	4	5	6	7
Cost Efficiency (Adapted from: Min et al. 2007; Fugate et al. 2009; Beamon 1999)	Far Below Competitors			On Par With			Far Above Competitors
For the following items, please rate your business unit's performance over the last year relative to your main competitors:							
Distribution costs (including transportation and handling costs).	1	2	3	4	5	6	7
Manufacturing costs (including labor, maintenance, and re-work costs).	1	2	3	4	5	6	7
Inventory costs (including inventory investment and obsolescence, work-in-progress, and finished goods).	1	2	3	4	5	6	7
Marketing costs (including advertising, sales and customer service related costs).	1	2	3	4	5	6	7
Supply chain costs as a percent of revenue.	1	2	3	4	5	6	7

Table 3.6 Continued

Financial Performance (Adapted from: Baker and Sinkula 1999; Matsuno et al. 2000; Fugate et al. 2009)	Far Below Competitors			On Par With			Far Above Competitors
In your judgment, how did you BUSINESS UNIT perform relative to its major competitor in the previous fiscal year with respect to each criterion? If you are associated with a company that does not consist of business units or divisions, please answer the following based on your company.							
Return on sales (ROS).	1	2	3	4	5	6	7
Return on assets (ROA).	1	2	3	4	5	6	7
Return on investments (ROI).	1	2	3	4	5	6	7
Profit Margin.	1	2	3	4	5	6	7

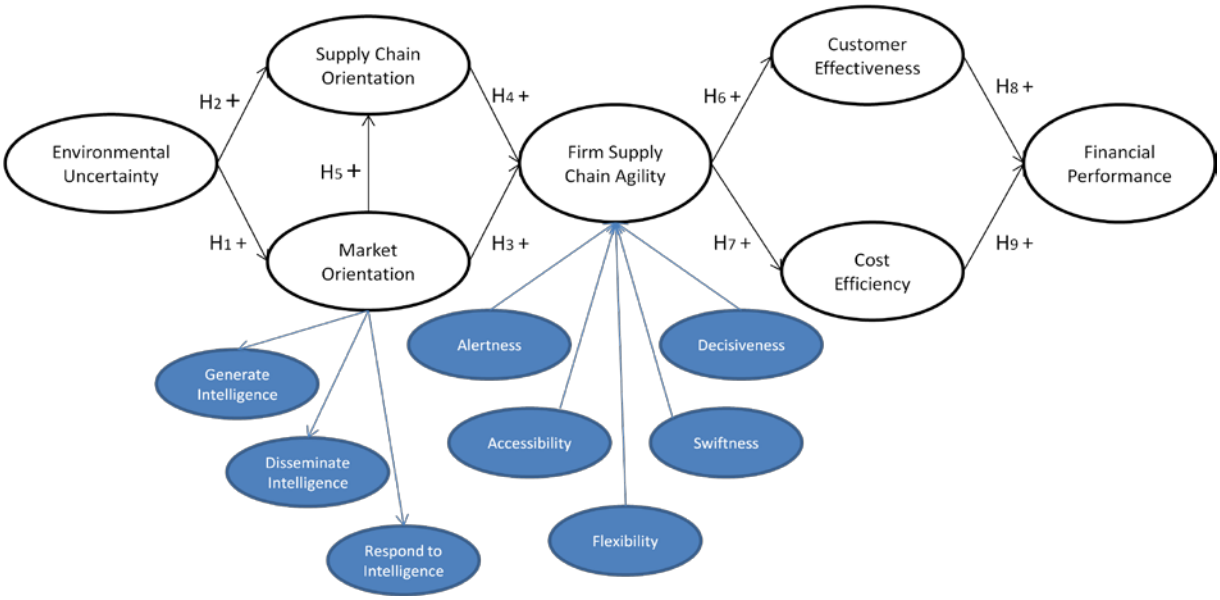

Figure 3.2

Theoretical Model of Firm Supply Chain Agility with Reflective and Formative Dimensions

Common Method Bias

Procedural methods were applied to minimize the potential for common method bias since both independent and dependent measures were obtained from the same source. There

are only five reverse-coded items (measuring market orientation), and all the hypotheses are stated in a positive direction (Swink and Song 2007). It was ensured that the sample included mid- to senior-level managers that had high levels of relevant knowledge, which tends to mitigate single source bias (Mitchell 1985). Common method bias was also reduced by separating the predictor and criterion variable items over the length of the survey instrument and by assuring participants that their responses would be kept anonymous (Podsakoff et al. 2003). In addition, scale items were arranged in a way that socially desirable measures were

Table 3.7

Business Setting Differences Survey Items

The following information will help the research team understand differences in various business settings.

(1) Which term best describes your industry? Please check all that apply.

_Automotive _Electronics _Chemicals/plastics
_Medical/pharmaceutical _Industrial products _Appliances
_Apparel/textiles _Consumer packaged goods _Other:_____

(2) What is the approximate annual sales revenue of your business unit?
_Less than $1 million
_$1-50 million
_$51-500 million
_$501 million-$1 billion
_1.1-$5 billion
_5.1-$10 billion
_ Greater than $10 billion

(3) 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

Table 3.7 Continued

(4) Please indicate how long you've been with your current firm:

_1 year _1-3 years
_3-5 years _5-10 years
_10-15 years _15-20 years
_20+years

(5) Please indicate how long you've been in your current position:

_1 year _1-3 years
_3-5 years _5-10 years
_10-15 years _15-20 years
_20+years

(6) Please indicate your level of education:

_High School _Some College
_College Graduate/Bachelor's Degree _Masters/MBA
_PhD

(7) Please indicate your current job title:

-

(8) Please indicate below the firm that you're associated with. This information would enable us to consult publically available annual reports to estimate firm performance. This is strictly confidential and will not be shared with any other party: -

spaced apart from one another (Nederhof 1985). Previous research was consulted and an iterative process of reviewing, pilot testing, and revising the survey with a group of academic experts, was conducted in an effort to minimize the potential for context effects (Lindell and Whitney 2001). Finally, the use of self-administered surveys helps reduce social acceptability cues that respondents might pick up on from the interviewer and/or other participants (Nederhof 1984; 1985).

Survey Pretest

In order to increase reliability, decrease measurement error, and improve the validity of the construct measurement the scale items were pretested (Dillman 2000). Three stages of pretesting were employed. The first two stages were focused solely on the refinement of the FSCA measurement instrument as most of the items measuring this concept were newly developed. The final stage included the FSCA measurement items generated from the first two stages of pretesting, along with the measurement items for the remaining constructs of interest (e.g., environmental uncertainty, supply chain orientation, market orientation, customer effectiveness, cost efficiency, and financial performance).

For the first phase of the pretest, a personalized email with a link to a Qualtrics-based Q-sort electronic document was sent to a group of 25 academic experts (Moore and Benbasat 1991; Li et al. 2009). The academic experts were selected based on their research interests, area of expertise and industry experience. The document contained the survey items for the supply chain agility construct, along with the definition of each construct dimension. Respondents were asked to place each item under the dimension they felt best represented the item. Further, the experts were asked to evaluate the items for face validity and provide qualitative feedback. Twenty responses were received, for an effective response rate of 80%. Based on the item placement ratios and the qualitative feedback received from academic experts, some survey items were revised, while others were selected for elimination. The purpose of the pilot test was to identify poor performing items rather than create highly purified scales (Defee et al. 2009). Table 3.8 presents the resultant firm supply chain agility measurement scale following the first pretesting stage.

Table 3.8
Firm Supply Chain Agility Survey Items Resultant from the First Pretest

Firm Supply Chain Agility: Alertness	Strongly Disagree			Neutral			Strongly Agree
Please indicate your level of agreement with the following statements:							
We can quickly detect **changes** in our environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
Our firm can promptly identify **opportunities** in its environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
My organization can rapidly sense **threats** in its environment. (Newly Developed)	1	2	3	4	5	6	7
We can notice **changes** in our environment quicker than our main competitors. (Newly Developed)	1	2	3	4	5	6	7
As compared to its main competitors, my company is faster to discover **opportunities** in its environment**.** (Newly Developed)	1	2	3	4	5	6	7
My company is more rapid to spot **threats** in its environment more rapidly than its main competitors. (Newly Developed)	1	2	3	4	5	6	7

Firm Supply Chain Agility: Accessibility	Strongly Disagree			Neutral			Strongly Agree
My company can access the information it needs to deal with **changes** in its environment. (Newly Developed)	1	2	3	4	5	6	7
We can obtain the information we need to address **opportunities** in our environment. (Newly Developed)	1	2	3	4	5	6	7
My firm can acquire the information it needs to respond to **threats** in its environment. (Newly Developed)	1	2	3	4	5	6	7
Our **suppliers** communicate relevant information to us. (Newly Developed)	1	2	3	4	5	6	7
Our **customers** share pertinent information with us. (Newly Developed)	1	2	3	4	5	6	7

Table 3.8 Continued

Firm Supply Chain Agility: Accessibility	Strongly Disagree			Neutral			Strongly Agree
We always receive the information we demand from our **suppliers**. (Newly Developed)	1	2	3	4	5	6	7
We always obtain the information we request from our **customers**. (Newly Developed)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Decisiveness	Strongly Disagree			Neutral			Strongly Agree
My company can make resolute decisions to deal with **changes** in its environment. (Newly Developed)	1	2	3	4	5	6	7
We can make definite decisions to address **opportunities** in our environment. (Newly Developed)	1	2	3	4	5	6	7
My organization can make firm decisions to respond to **threats** in its environment. (Newly Developed)	1	2	3	4	5	6	7
In our firm we have processes in place to facilitate decision-making. (Newly Developed)	1	2	3	4	5	6	7
Our supply chain managers are empowered to make decisions within their area of expertise. (Newly Developed)	1	2	3	4	5	6	7
As compared to our competitors, my company is more resolute at making decisions regarding supply chain operations. (Newly Developed)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Swiftness	Strongly Disagree			Neutral			Strongly Agree
We can promptly realize changes to our supply chain operations. (Newly Developed)							
My company is faster at implementing supply chain changes/decisions than its competitors. (Newly Developed)	1	2	3	4	5	6	7
As compared to our competitors, my company is quicker at executing supply chain operations. (Newly Developed)	1	2	3	4	5	6	7

Table 3.8 Continued

Firm Supply Chain Agility: Swiftness	Strongly Disagree			Neutral			Strongly Agree
My firm can quickly reconfigure supply chain resources to respond to **changes** in the environment (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
To address opportunities in our environment, we can rapidly reorganize our supply chain resources. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
We can swiftly reconfigure supply chain resources to deal with **threats** in our environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Flexibility	Strongly Disagree			Neutral			Strongly Agree
When needed, we can adjust our supply chain operations to the extent necessary to execute our decisions. (Newly Developed)	1	2	3	4	5	6	7
We have a wider range of adjustments that we can make to our supply chain operations than our competitors. (Newly Developed)	1	2	3	4	5	6	7
My firm can increase its short-term capacity as needed. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
My company can usually meet an increase in order-size. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
We can adjust the specification of orders as requested by our customers. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
Our firm can adjust/expedite its delivery lead times. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7

Table 3.8 Continued

Firm Supply Chain Agility-Reflective Measures (Developed in this dissertation)	Strongly Disagree			Neutral			Strongly Agree
My company quickly reconfigures supply chain operations to address **changes** in the environment. (Newly Developed)	1	2	3	4	5	6	7
My firm rapidly adjusts supply chain operations to respond to **opportunities** in the environment. (Newly Developed)	1	2	3	4	5	6	7
My firm swiftly alters supply chain operations to react to **threats** in the environment. (Newly Developed)	1	2	3	4	5	6	7

Next, the survey instrument in Table 3.8 was pretested using a random sample of supply chain managers drawn from a database of potential participants. The database of mid- and upper-level logistics, supply chain, and operations managers of North American companies was obtained from Dun&Bradstreet, a leading provider of business information. A similar procedure to the one employed during the first phase of pretesting was employed. Specifically, a personalized email, with a link to a Qualtrics-based Q-sort electronic document was sent to a sample of 272 managers. The document contained the survey items for the supply chain agility construct presented in Table 3.8, along with the definition of each construct dimension. Respondents were asked to place each item under the dimension they felt best represented the item. Their responses were used to determine item placement ratios. Also, the experts were asked to evaluate the items for face validity and provide qualitative feedback. One hundred responses were received, resulting in a response rate of 27.2%. The managers represented a wide array of industry sectors including manufacturing-general (16%), manufacturing-consumer products, transportation (15%), retail (9%) and other twelve other sectors which accounted for

the remaining 40% of respondents. Annual sales for the respondents' companies ranged from less than $250 million to greater than $9 billion. The dominant group was represented by companies with revenues of less than $250 million (22%). Also, the level of professional work experience exceeded 20 years for 49% of the respondents (Table 3.9).

The results of the second Q-sort pretest indicated that, except for four items, item placement ratios exceeded the recommended level of 0.70 (Moore and Benbasat 1991) considered acceptable for exhibiting content validity (Table 3.10), while the inter-judge agreement exceeded the recommended 0.65 value (Perreault and Leigh 1989). The accurate placement ratio for each item is bolded in Table 3.10. Based on these results, and the qualitative feedback received from the managers, six survey items were revised and one was eliminated. Table 3.11 presents the resultant firm supply chain agility measurement scale following the second pretesting stage. These items were used for the final pretest.

All survey items were included in the final pretest. Thirty (30) items were used to measure firm supply chain agility (Table 3.11), 17 items for market orientation (Table 3.3), 13 items for supply chain orientation (Table 3.4), 6 items for environmental uncertainty (Table 3.5), 9 items for customer effectiveness (Table 3.6), 5 items for cost efficiency (Table 3.6), and 4 items for financial performance (Table 3.6). The internet-based survey questionnaire was emailed to a sample of 526 mid- and upper-level supply chain and logistics managers of North American companies. The sample was purchased from Dun&Bradstreet, a leading provider of business information. The electronic surveys generated 78 usable responses, which yielded a response rate of 14.8%.

Table 3.9
Demographics for the Second Pretest Sample

Level of Professional Work Experience	Percentage	Total Company Annual Sales	Percentage	Type of Industry	Percentage
<1 year	6%	<$250 million	22%	Energy/Chemical/Mining	6%
1-3 years	6%	$250 million-$500 million	11%	Communications/Media/ Entertainment	4%
3-5 years	9%	$500 million-$1 billion	7%	Retail	9%
5-10 years	11%	$1-$2 billion	17%	Manufacturing-General	16%
10-15 years	9%	$2-$3 billion	10%	Manufacturing-Consumer products	15%
15-20 years	10%	$3-$5 billion	9%	Manufacturing-Aerospace/defense	3%
20+ years	49%	$5-$9 billion	9%	Manufacturing-High technology	5%
		>$9 billion	15%	Energy/Chemical/Mining	6%
				Financial Services/Insurance	3%
				Life Sciences-Pharmaceuticals	1%
				Life Sciences-Medical devices	1%
				Health Managed Care	2%
				Transportation Service Provider	15%
				Other	20%
Total	100%		100%		100%

Importantly, the purpose of the final pilot test was to identify poor performing items rather than create highly purified scales (Defee et al., 2009). To be retained in a scale, items had to exceed the recommended 0.70 cutoff for alpha (Churchill, 1979). Exploratory, followed by Confirmatory Factor Analysis, were also conducted to determine whether the item loadings were clean (no cross-loading between constructs that are supposed to be different from each other) (Mentzer and Flint, 1997). No items were eliminated at this stage.

Main Test

Data Collection

Potential respondents from both databases (i.e., Supply Chain Forum and SurveyMonkey) used were pre-qualified using the procedures suggested by Dillman (2000) and

Table 3.10

Results of the Second Pretest/Managers' Q-Sort Exercise

No.	Question	Dimensions					Total Percentage
		Alertness	Accessibility	Decisiveness	Swiftness	Flexibility	
1	We can notice changes in our environment quicker than our main competitors.	**75%**	12%	9%	0%	4%	100%
2	My company is more rapid to spot threats in its environment than its main competitors.	**71%**	9%	7%	7%	6%	100%
3	We can obtain the information we need to address opportunities in our environment.	7%	**75%**	8%	4%	6%	100%
4	My firm can acquire the information it needs to respond to threats in its environment.	14%	**73%**	6%	4%	3%	100%
5	Our supply chain managers are empowered to make decisions within their area of expertise.	0%	8%	**76%**	8%	8%	100%
6	We can make definite decisions to address opportunities in our environment.	7%	7%	**74%**	8%	4%	100%

Table 3.10 Continued

No.	Question	Dimensions					Total Percentage
		Alertness	Accessibility	Decisiveness	Swiftness	Flexibility	
7	As compared to our competitors, my company is quicker at executing supply chain operations.	2%	6%	6%	**78%**	8%	100%
8	My firm can quickly reconfigure supply chain resources to respond to changes in the environment.	8%	9%	7%	**24%**	52%	100%
9	When needed, we can adjust our supply chain operations to the extent necessary to execute our decisions.	2%	5%	2%	4%	**87%**	100%
10	My firm can increase its short-term capacity as needed.	5%	6%	6%	10%	**73%**	100%
11	My company can make resolute decisions to deal with changes in its environment.	3%	3%	**75%**	11%	8%	100%
12	We can quickly detect changes in our environment.	**75%**	12%	6%	2%	5%	100%
13	Our firm can promptly identify opportunities in its environment.	**71%**	12%	6%	7%	4%	100%
14	Our suppliers communicate relevant information to us.	9%	**73%**	5%	5%	8%	100%
15	We always receive the information we demand from our suppliers.	7%	**75%**	4%	5%	9%	100%
16	My organization can make firm decisions to respond to threats in its environment.	4%	8%	**73%**	8%	7%	100%
17	In our firm we have processes in place to facilitate decision-making.	3%	2%	**74%**	18%	3%	100%

Table 3.10 Continued

No.	Question	Dimensions					Total Percentage
		Alertness	Accessibility	Decisiveness	Swiftness	Flexibility	
18	We can promptly realize changes to our supply chain operations.	46%	14%	9%	**21%**	10%	100%
19	We have a wider range of adjustments that we can make to our supply chain operations than our competitors.	7%	7%	6%	9%	**71%**	100%
20	My company can usually meet an increase in order-size.	4%	7%	5%	6%	**78%**	100%
21	We can adjust the specification of orders as requested by our customers.	2%	3%	3%	6%	**86%**	100%
22	My organization can rapidly sense threats in its environment.	**75%**	11%	5%	4%	5%	100%
23	As compared to its main competitors, my company is faster to discover opportunities in its environment.	**75%**	5%	8%	8%	4%	100%
24	Our customers share pertinent information with us.	12%	**76%**	6%	2%	4%	100%
25	My company can access the information it needs to deal with changes in its environment.	14%	**72%**	6%	4%	4%	100%
26	In our firm we have processes in place to facilitate decision-making.	2%	10%	**71%**	14%	3%	100%
27	As compared to our competitors, my company is more resolute at making decisions regarding supply chain operations.	5%	6%	**80%**	4%	5%	100%

Table 3.10 Continued

No.	Question	Dimensions					Total Percentage
		Alertness	Accessibility	Decisiveness	Swiftness	Flexibility	
28	My company is faster at implementing supply chain changes/decisions than its competitors.	2%	2%	4%	**81%**	11%	100%
29	To address opportunities in our environment, we can rapidly reorganize our supply chain resources.	13%	7%	7%	**21%**	52%	100%
30	We can swiftly reconfigure supply chain resources to deal with threats in our environment.	10%	6%	12%	**30%**	42%	100%
31	Our firm can adjust/expedite its delivery lead times.	2%	2%	3%	5%	**88%**	100%
32	We always obtain the information we request from our customers.	12%	**73%**	4%	4%	7%	100%

Kerlinger and Lee (2000). Following the purification of the measurement instrument, the main survey test was sent to the sample of 285 potential respondents selected from the database of the university's Supply Chain Management Forum members, and the sample of 1135 pre-qualified SurveyMonkey panel members. Two reminders spaced one week apart followed the initial email to the sample of Supply Chain Management Forum members. Once all the data collection methods had been concluded, a number of 141 usable responses were received from the sample of Supply Chain Management Forum members for a response rate of 49.47%. No reminder was sent to the SurveyMonkey panel members because of the initial high response rate.

Table 3.11

Firm Supply Chain Agility Survey Items Resultant from the Second Stage of Pretesting

Firm Supply Chain Agility: Alertness	Strongly Disagree			Neutral			Strongly Agree
Please indicate your level of agreement with the following statements:							
We can quickly detect **changes** in our environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
Our firm can promptly identify **opportunities** in its environment. (Adapted from Li et al. 2009)	1	2	3	4	5	6	7
My organization can rapidly sense **threats** in its environment. (Newly Developed)	1	2	3	4	5	6	7
We can notice **changes** in our environment quicker than our main competitors. (Newly Developed)	1	2	3	4	5	6	7
As compared to its main competitors, my company is faster to discover **opportunities** in its environment**.** (Newly Developed)	1	2	3	4	5	6	7
My company spots **threats** in its environment more rapidly than its main competitors. (Newly Developed)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Accessibility	Strongly Disagree			Neutral			Strongly Agree
My company can access the information it needs to deal with **changes** in its environment. (Newly Developed)	1	2	3	4	5	6	7
We can obtain the information we need to address **opportunities** in our environment. (Newly Developed)	1	2	3	4	5	6	7
My firm can acquire the information it needs to respond to **threats** in its environment. (Newly Developed)	1	2	3	4	5	6	7
Our **suppliers** communicate relevant information to us. (Newly Developed)	1	2	3	4	5	6	7
Our **customers** share pertinent information with us. (Newly Developed)	1	2	3	4	5	6	7

Table 3.11 Continued

Firm Supply Chain Agility: Accessibility	Strongly Disagree			Neutral			Strongly Agree
We always receive the information we demand from our **suppliers**. (Newly Developed)	1	2	3	4	5	6	7
We always obtain the information we request from our **customers**. (Newly Developed)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Decisiveness	Strongly Disagree			Neutral			Strongly Agree
My company can make resolute decisions to deal with **changes** in its environment. (Newly Developed)	1	2	3	4	5	6	7
We can make definite decisions to address **opportunities** in our environment. (Newly Developed)	1	2	3	4	5	6	7
My organization can make firm decisions to respond to **threats** in its environment. (Newly Developed)	1	2	3	4	5	6	7
In our firm we have processes in place to facilitate decision-making. (Newly Developed)	1	2	3	4	5	6	7
Our supply chain managers are empowered to make decisions within their area of expertise. (Newly Developed)	1	2	3	4	5	6	7
As compared to our competitors, my company is more resolute at making decisions regarding supply chain operations. (Newly Developed)	1	2	3	4	5	6	7
Firm Supply Chain Agility: Swiftness	Strongly Disagree			Neutral			Strongly Agree
My company implements supply chain changes/decisions faster than its main competitors. (Newly Developed)	1	2	3	4	5	6	7
As compared to our competitors, my company is quicker at executing supply chain operations. (Newly Developed)	1	2	3	4	5	6	7
My firm can quickly respond to **changes** in the business environment. (Newly Developed)	1	2	3	4	5	6	7
We can rapidly address **opportunities** in our environment. (Newly Developed)	1	2	3	4	5	6	7
We can swiftly deal with **threats** in our environment. (Newly Developed)	1	2	3	4	5	6	7

Table 3.11 Continued

Firm Supply Chain Agility: Flexibility	Strongly Disagree			Neutral			Strongly Agree
When needed, we can adjust our supply chain operations to the extent necessary to execute our decisions. (Newly Developed)	1	2	3	4	5	6	7
We have a wider range of adjustments that we can make to our supply chain operations than our competitors. (Newly Developed)	1	2	3	4	5	6	7
My firm can increase its short-term capacity as needed. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
My company can usually meet an increase in order-size. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
We can adjust the specification of orders as requested by our customers. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
Our firm can adjust/expedite its delivery lead times. (Adapted from Tachizawa and Gimenez 2010)	1	2	3	4	5	6	7
Firm Supply Chain Agility-Reflective Measures (Developed in this dissertation)	Strongly Disagree			Neutral			Strongly Agree
My company quickly reconfigures supply chain operations to address **changes** in the environment. (Newly Developed)	1	2	3	4	5	6	7
My firm rapidly adjusts supply chain operations to respond to **opportunities** in the environment. (Newly Developed)	1	2	3	4	5	6	7
My firm swiftly alters supply chain operations to react to **threats** in the environment. (Newly Developed)	1	2	3	4	5	6	7

A number of 530 usable responses were received from the SurveyMonkey panel members for a response rate of 46.69%. Responses from the two samples were compared using ANOVA and no significant differences were found. Combined, the two samples generated a total of 671 usable responses.

Non-response Bias

For the survey sent to the sample of Supply Chain Management Forum members, non-response bias was initially assessed by comparing first and second waves of survey responses using ANOVA (Armstrong and Overton, 1977). Non-response bias was also examined using the guidelines suggested by Mentzer and Flint (1997). A random sample of 30 non-respondents was contacted and asked to respond to five non-demographic questions. Specifically, the five questions addressed the construct of firm supply chain agility. A similar procedure was employed to test non-response bias for the SurveyMonkey panel members: a random sample of 30 non-respondents was contacted and asked to respond to five non-demographic questions. For both samples (Supply Chain Management Forum members and SurveyMonkey panel members), no statistical difference was found between the answers to these questions of respondents and non-respondents. Therefore, non-response bias is not considered a problem with the data.

Analysis of Scale Measurement Reliability and Validity

Prior to purification of the measurement items, basic statistical analyses of the collected data were performed, such as examination of incorrect coding, mean, minimum and maximum values, standard deviation, and normality tests (i.e., skewness and kurtosis). The primary approaches for measurement item purification included multiple iterations of confirmatory factor analysis (CFA), with the maximum likelihood estimation (MLE) method that iteratively improves parameter estimates to minimize a specified fit function. In addition to the statistical analyses, theoretical assessment was made prior to final deletion of any measurement items. When modifying the model, indicators such as offending estimates, squared multiple

correlations, standardized residual covariances, and modification indices were considered. In the category of offending estimates a check was performed for negative error terms, standardized coefficients exceeding or very close to 1.0, and very large standard errors. Squared multiple correlations (SMC) were reviewed as well to locate any relatively small SMC values that indicate the portion of a variable's variance that is accounted for by its predictor is minimal at best (Joreskog and Sorbom 1989). Any SMC values of 0.20 or less were put to the test of deletion. Standardized residuals are the differences between the observed covariance and the estimated covariance matrix, and significant residuals (greater than |2.58| which is statistically significant at the 0.05 level) indicate a substantial prediction error for a pair of indicators (Hair et al. 1998).

The modification index (MI) is a measure of whether an item loaded on multiple factors. For the value of the MI, a coefficient value equal or greater than 3.85 indicates that chi-square can be statistically significantly reduced with the estimation of the coefficient. If a more conservative approach is taken, a value of MI equal to or greater than ten would recommend an item for deletion (Fassinger 1987). The more conservative value of 10 was used for this dissertation. This was done based on the assumption that most of the multi-loaded items had already been screened out in the pretest.

Before proceeding with testing of the hypothesized relationships, unidimensionality, reliability, convergent validity, and discriminant validity of the constructs were evaluated. The measures for each variable were examined for unidimensionality to verify the existence of one latent construct underlying a set of measures (Hattie 1985). Confirmatory factor analysis was used to test for each construct by itself, then for all possible pairs, and finally for each the

overall measurement model and each construct in the presence of other constructs (Medsker et al. 1994; Garver and Mentzer 1999).

Reliability was assessed using Cronbach's Coefficient Alpha, with the rule of thumb that an alpha above .70 indicates good correlation between the item and the true scores and lower alpha levels suggest that the sample of items is a poor indicator of the construct (Churchill 1979). Also, because coefficient alpha tends to underestimate scale reliability and has several limitations, the guidelines suggested by Garver and Mentzer (1999) were followed as well. If the construct reliability measure is greater than 0.70 and the variance extracted is 0.50 or greater, then the support for reliability is adequate.

Construct validity was examined through both convergent validity and discriminant validity. Convergent validity was judged by assessing the overall fit of the measurement model, the magnitude, direction, and statistical significance of the estimated parameters between the latent variables and their indicators, with 0.70 being the value of substantial magnitude of the parameter estimate (Garver and Mentzer 1999). Also, the average variance extracted for all constructs should be above the threshold of 0.50 as suggested by Fornell and Larcker (1981).

Discriminant validity refers to the degree to which measures for different constructs are distinct from each other. Discriminant validity was first assessed using the average variance extracted method (Fornell and Larcker 1981). A check was performed to determine whether the average variance extracted for each pair of constructs was greater than their squared correlation. It was also examined whether any single item loaded more highly on another construct than on the one it was intended to measure. Discriminant validity was further assessed by running a series of nested CFA model comparisons in which the covariance

between each pair of constructs (one pair at a time) was constrained to one (Anderson and Gerbing 1988; Bagozzi and Yi 1988). If the chi-square difference test is significant when all of the correlations between the constructs are fixed to one for the theoretical model, and for the measurement model allowing the two constructs to correlate freely, then the constructs were deemed to discriminate adequately.

CHAPTER 4 - ARTICLE 1: A MULTIDISCIPLINARY APPROACH TO SUPPLY CHAIN AGILITY: CONCEPTUALIZATION AND SCALE DEVELOPMENT

INTRODUCTION

Agility has emerged as a dominant competitive vehicle for organizations operating in uncertain and ever-changing business environments, and has been heralded as the business paradigm of the 21st century (Tseng and Lin 2011). Businesses no longer compete as solely autonomous entities, but rather as supply chains (Lambert and Cooper 2000; Christopher 2005; Defee and Stank 2005; Stank et al. 2005), and supply chain members who are capable of rapidly aligning their collective capabilities to respond to changes in demand and supply should enjoy advantages (Gligor and Holcomb 2012a). Firms that can align with suppliers and customers to coordinate operations achieve a level of agility beyond that of competitors' (Lin et al. 2006). As supply chain agility has progressed from a conference topic to a practical imperative for most companies (White et al. 2005), it has been highlighted as a fundamental characteristic of the "best" supply chains (Lee 2004).

In spite of its increased importance (Lee 2004), the theoretical basis of supply chain agility is fragmented (Li et al. 2008). Agility is a broad and multidimensional concept bridging many disciplines (Gligor and Holcomb 2012a), and this multidimensionality has led to much confusion and ambiguity (Giachetti et al. 2003; Li et al. 2009; Gligor and Holcomb 2012a). Elements and linkages among agility elements are underdeveloped, and it is uncommon for any two authors to adopt the same definition (Conboy 2009). A rigorously validated survey instrument is needed to enable researchers to credibly build on theories regarding causal links

among agility-related capabilities, practices and performance outcomes (Sherehiy et al. 2007; Li et al. 2009).

This research addresses the confusion surrounding the multiple dimensions and definitions of firm supply chain agility (FSCA) by employing a multidisciplinary literature review. Specifically, the sports science and military science theoretical bases are investigated to better understand agility and identify its dimensions, and define it in a supply chain context. Further, a comprehensive measurement instrument that draws on the foundations of social and life science theory is developed and empirically validated so that researchers can rigorously expand agility theory.

LITERATURE REVIEW

Business scholars have defined agility in various ways emphasizing different aspects of the concept (Gligor and Holcomb 2012a). Through their comprehensive examination of the literature, Gligor and Holcomb determined that the definition and concept of agility is evolving. For example, much of the earlier research described agility as an ability that enabled firms to thrive in an environment of continuous and often unanticipated change (Gunasekaran 1998; 1999; Dove 1999; Sharifi and Zhang 1999; Sarkis 2001). More recently, Vinodh (2010) conceptualized it as a paradigm that facilitates companies to quickly respond to customers' dynamic demands. The concept, which initially concentrated on manufacturing, has expanded to become a wide-ranging response to a myriad of business challenges in a turbulent environment (Zhang 2011; Yauch 2011). Yet, despite its evolution, inconsistencies in the

multiple business definitions of agility have been further manifested in the existing supply chain research in its treatment of agility as a firm concept. As Gligor and Holcomb (2012a) note, few researchers provide a formal supply chain agility definition, and there is no agreement on its dimensionality (Li et al. 2008). For example, Swafford et al. (2006) define agility as the capability to adapt or respond in a speedy manner to a changing marketplace environment, while Costantino et al. (2012) define it as a network of different companies integrated with streamlined material, information and financial flow, and focused on flexibility and performance.

Few empirical research articles acknowledge agility's multidimensionality (Li et al. 2009; Braunscheidel and Suresh 2009). Li et al. (2009) identify the *alertness to change* and the *response capability* dimensions. The resultant measurement instrument characterizes supply chain agility in terms of six factors: strategic alertness, strategic response capability, operational alertness, operational response capability, episodic alertness, and episodic response capability. One significant research limitation is the lack of detail on the composition of the *response capability*. An agile supply chain is described as being alert to changes and capable of responding to changes. However, no information is offered on how the response capability is developed or what that capability entails. Braunscheidel and Suresh (2009) defined firm supply chain agility as a second-order construct that is formed by the first order dimensions of *demand response*, *joint planning, customer responsiveness,* and *visibility.* A significant weakness of this operationalization is the lack of theoretical rationale surrounding its development; no information is offered on how the four dimensions were identified.

The current research develops a comprehensive conceptualization and measurement scale of firm supply chain agility that explores the multidimensionality of the concept. Foundational social and life science theory identifies five firm supply chain agility dimensions, including alertness, accessibility, decisiveness, swiftness, and flexibility. The dimensions are used to define a firm's supply chain agility as *a firm's ability to quickly adjust tactics and operations within its supply chain to respond or adapt to changes, opportunities or threats in its environment.* The following subsections present the literature review that lead to the emergence of the supply chain agility dimensions.

Alertness

Alertness emerged as an agility dimension from a variety of domains both in foundational social and military science as well as in business. In sports science discipline, Sheppard and Young (2006) describe alertness as a rapid whole-body movement with change of velocity or direction in response to a stimulus, while Farrow et al. 2005 define agility as basic movements requiring the player to perform sudden changes in body direction. The ability of players to execute agility tasks is considered dependent upon factors such as visual-scanning techniques, visual-scanning speed, visual processing, perception and anticipation (Chelladurai 1976; Abernethy et al. 1999; Young et al. 2002; Sheppard and Young 2006). These factors are reflected in the players' on-field agility (Gore 2000). It has been suggested that elite performers differ from non-elite performers in their ability to anticipate the opponents' movements (Abernethy and Russell 1987). Some agility tests indicate that high-performance sports players initiate a change of direction movement before the opponent's ball release due to anticipation of the other players' movements (Sheppard and Young 2006). Visual search and anticipation

research have also shown that highly skilled athletes are able to successfully predict the action of an opponent before it is carried out (Bradshaw et al. 2010). The national protocol for the assessment of agility performance in team-sport athletes also recognizes the role of alertness and suggests that the athletes' ability to successfully use agility maneuvers in the actual game depends on factors such as visual processing, timing, reaction time, perception, and anticipation (Ellis et al. 2000).

Various conceptualizations of alertness have been introduced in military science. Dekker (1999) sees agility as the ability to perceive an upcoming threat and respond to it quickly, while the US Army defines it more simply as the ability of friendly forces to act faster than the enemy (US Army 1997). It has been suggested that creating an agile military force requires speeding up the so-called OODA (observe, orient, decide, act) loop (Fewell and Hazen 2005). The concept of an OODA loop was developed by military strategist USAF Colonel John Boyd, and was originally applied at the operational and strategic levels in military combat operations. The alertness dimension of agility is captured within the *observe* and *orient* stages of the loop and is a prerequisite to an agile response. Some military science researchers refer to the alertness capability as situational awareness, and describe it as the perception of environmental elements with respect to time and space (Dekker 2006; Sheffer 2006). The speed of recognition of environmental elements is considered critical (Alberts 2007). In combat, military forces require early awareness of upcoming threats. The quicker changes are detected, the sooner the response can be deployed.

The dimension of alertness has also been a focus of business agility research. Sharifi and Zhang (1999) recognize that agile organizations need a basic ability that consists of sensing,

perceiving, and anticipating changes in the business environment. Zhang and Sharifi (2000) divided agility capabilities into four major categories: responsiveness (ability to identify, respond to, and recover from changes quickly, reactively or proactively), competency (ability to efficiently and effectively realize enterprise objectives), flexibility/adaptability (ability to implement different processes and apply different facilities to achieve the same goals), and speed (ability to complete an activity as quickly as possible). This research expands on Zhang and Sharifi's work and posits alertness as a distinct dimension of agility. Other research articles also recognize the role of alertness in the design of agile manufacturing systems (Goldman et al. 1995; Almahamid et al. 2010 Inman et al. 2011; Vinodh and Prasanna 2011; Zhang 2011).

The role of alertness in achieving the desired level of agility is also emphasized within information systems and information systems development research. Sarker and Sarker (2009) argue that agility lies in environmental scanning and sense-making routines for anticipating and recognizing possible or imminent crises, while other authors emphasize the important role of sensing market opportunities and threats (Tseng and Lin 2011; Lu and Ramamurthy 2012; Tallon and Pinsonneault 2011). Within a supply chain management context, Christopher (2000) was the first to acknowledge that, to be truly agile, a supply chain must be capable of *reading* and *responding* to real demand. He refers to this capability as market sensitivity. One limitation of Christopher's interpretation is that although he recognizes the importance of *reading* customers' requirements, he doesn't conceptualize it as a distinct capability. Similar to Haeckel's sense-and-respond model (Haeckel 1995), he places it in the same category with the *responding* to real demand capability. Another drawback of Christopher's research is that it only recognizes the importance of reading demand information, with no reference to supply.

Other supply chain researchers also recognize that agility requires a timely awareness of change and adopt the market sensitivity dimension introduced by Christopher (Lin et al. 2006; Agarwal et al. 2007; Jain et al. 2008). However, it was Li et al. (2008) that first conceptualized alertness as a distinct dimension of supply chain agility. These authors argue that agile supply chains must be alert to changes, within the supply chain itself and within the surrounding environment. This dimension of agility manifests itself through sensing emerging market trends, listening to customers, and monitoring real demand through daily point-of-sale data (Li et al. 2008; 2009). Based on the reviewed literature, *alertness* is defined as *the ability to quickly detect changes, opportunities, and threats.*

Accessibility

Research suggests that once a change is detected through the alertness capability, firms must also be able to access relevant data to decide how to provide an agile response (Gunasekaran 1998; Sharp et al. 1999; Jain et al. 2008; Vinodh and Prasanna 2011; Tseng and Ling 2011; Lu and Ramamurthy 2012). Supply chain-wide information access is recognized as a key requirement for supply chain agility (Vinodh and Prasanna 2011; Gligor and Holcomb 2012b). In his seminal article, Christopher (2000) argues that agile supply chains must possess a number of distinguishing characteristics. Agile supply chains must be *virtual;* that is, they must be information-based rather than inventory-based. Supply chain members must share real-time demand, inventory, and production information (Ahn et al. 2012). The creation of virtual supply chains allows all supply chain members to access relevant data and make informed decisions about how to respond to changes detected in the environment. Lin et al. (2006) refer to the capacity to access information as *information integration,* and describe it as the ability to use

information technology to share data between buyers and supplies. Information integration can be considered the infrastructure needed to create a virtual supply chain (Christopher et al. 2004; Jain et al. 2008).

Manufacturing research also suggests that a requirement for designing agility is the creation of an environment where relevant information can be accessed. Goldman et al. (1995) consider the formation of virtual partnerships to be one of the four primary principles of agility. This perspective is supported by other manufacturing research articles that identify virtual enterprises, information technology and communication as key enablers of agility (Gunasekaran 1998; Sharp et al. 1999; Khalil and Wang 2002; Cao and Dowlatshahi 2005; Eshlaghy et al. 2010; Zhang 2011; Costantino et al. 2012). Information systems and information systems development research also provide substantial empirical evidence for considering information integration as a key enabler of agility (Clark et al. 1997; Zaheer and Zaheer 1997; Gosain et al. 2005; van Oosterhout et al. 2006; Fink and Neumann 2007; Mathiassen and Vainio 2007; Zhang and Sharifi 2007; Goodhue et al. 2009; Tseng 2011; Lu and Ramamurthy 2012). A high level of integration makes possible timely and accurate information gathering and sharing (Lu and Ramamurthy 2012). Real-time access to information allows supply chain members to quickly detect changes in customers' needs (Overby et al. 2006). Sheffer (2006) considers the ability to provide an agile response contingent upon effective information collection and dissemination. This perspective is also shared by Atkinson and Moffatt (2005) who argue that information availability is a necessary condition for agility. *Accessibility* emerged from the literature review as the second dimension of agility. It is defined as *the ability to access relevant data*.

Decisiveness

Sports science and military science research suggest that agility is dependent upon the ability to make resolute decisions using the available information. Motor learning researchers have recognized the role of decision making in agility tasks. They managed to isolate the decision-making time of players in order to evaluate its contribution to agility performance (Sheppard and Young 2006). Decision-making time is measured by the time elapsed between the moment a stimulus is presented to the player and the player's movement initiation (Bradshaw et al. 2010). Researchers control the alertness and accessibility aspects of agility by presenting the stimulus to the player (limited need for detection) and by offering the information on how to respond to the stimulus (limited need for information accessibility).

The impact of decision-making abilities on agility has been investigated across a variety of sports-related contexts (Chelladurai 1976). Helsoen and Pauwels (1988) presented expert and novice soccer players with a life-size film display of various tactically-oriented patterns of soccer drills. The subjects were asked to physically respond to the footage when the ball appeared to be kicked toward them by shooting for goal, passing to a team mate, or dribbling past an opponent. The simulation revealed that expert players possess superior decision-making skills as compared to novice players. Research shows that superior performance in open-skilled sports is ultimately determined by effective decision-making skills (Abernethy 1991). Offensive players, who demonstrate proficient agility, employ superior decision-making skills in response to the movements and body positions of the opposing defenders (Sayers 2000). Wheeler and Sayers (2010) research of rugby players investigated the role of decision-making abilities when executing agility tasks. The authors concluded that decision-making drills

must be incorporated in agility training programs (Wheeler and Sayers 2010). Their findings concur with other research that has shown that the inclusion of decision-making elements results in different levels of agility performance (Farrow et al. 2005; Sheppard and Young 2006; Bradshaw et al. 2010). Within Australian Rules football, decision-making skills were found to be important agility enablers as they help offensive players successfully evade opponents (Bradshaw et al. 2010).

In their definition of agility, Young et al. (2002) recognize that the two main components of agility are change of direction speed and decision-making factors. Other agility conceptualizations also acknowledge the contribution of decision-making abilities to agility performance in sports (Chelladurai 1976; Abernethy et al. 1999; Sheppard and Young 2006). Research also suggests that, as the complexity of the task increases, decision making skills become more important (Sheppard and Young 2006). The increase in complexity affects an athlete's performance as evidenced by the weak correlation between straight sprinting ability and the ability to perform complex agility tasks (Tsitskarsis et al. 2003). The decision-making component of agility can help explain why straight sprinting performance (limited decision-making required) has little to do with agility performance. Previous research has observed less than fifty percent commonality between reactive (decision required) and pre-planned (no decision required) agility performance (Farrow et al. 2005).

In a supply chain context, Christopher (2000) makes a clear distinction between speed (meeting customer demand through shortened delivery lead times) and agility (responding quickly to changes in demand in terms of both volume and variety). Military science research also recognizes the importance of decisiveness. The *decide* phase is one of the components of

the OODA (observe, orient, decide, act) loop (Fewell and Hazen 2005). A three-step sequential process takes place during the *decide* phase: options generation, best option selection, and best option adaptation. Speeding up the *decide* phase is suggested to result in a more agile response (Dekker 2006).

The above literature review indicates that in order to develop supply chain agility it is not enough to create the abilities to quickly detect changes (alertness) and access relevant information on how to deal with changes (accessibility). Firms must also foster the ability to make resolute decisions on how to respond to changes (decisiveness). *Decisiveness*, the third dimension of agility, is defined as *the ability to make decisions resolutely*. Combined, the alertness, accessibility, and decisiveness dimensions of agility form the cognitive area of firm supply chain agility. These dimensions are related to information-processing and allow the firm to determine what actions to take in response to changes, opportunities, or threats.

Swiftness

Once a decision is made on how to respond to changes, entities must be able to quickly implement those decisions (Sharp et al. 1999; Gunasekaran and Yusuf 2002; Lin et al. 2006; Alberts 2007; Mackley et al. 2008; Jain et al. 2008).Sports and military science research recognize the enabling role of swiftness in fostering agility. Research on the effects of agility training on athletic power performance indicates that agility is highly dependent on the athlete's speed of movement (Sporis et al. 2010). Various sports agility tests have also identified change of direction speed as one of the pivotal components of agility (Young et al. 2002; Farrow et al. 2005). While the terminology might vary across research articles (e.g., quickness, rapidness, swiftness, speed, velocity), a majority recognize swiftness as an essential

component of agility (Clarke 1959; Mathews 1973; Draper and Lancaster 1985; Bloomfield et al. 1994; Moreno 1995; Twist and Benicky 1996; Sayers 2000; Young et al. 2002; Tsitskarsis et al. 2003; Sheppard and Young 2006). Military science research also acknowledges swiftness by emphasizing the role of speed of movement (Dekker 2006) and speed of action (Alberts 2007; Mackley et al. 2008) in facilitating an agile response.

In business research, Christopher (2000) suggests that one of the required capabilities of agile supply chains is quickness, and defines it as the ability to complete an activity as quickly as possible. This ability is consistently recognized as a key enabler of agility across supply chain management research (Sharp et al. 1999; Lin et al. 2006; Jain et al. 2008). Swiftness is also captured within Li et al.'s (2008; 2009) *response capability* dimension of firm supply chain agility. Kumar and Motwani (1995) refer to the *swiftness* dimension of agility as the ability to accelerate activities on a critical path.

Manufacturing research provides additional support for considering swiftness a dimension of agility. Sharifi and Zhang (1999) argue that quickness is one of the necessary capabilities of an agile organization. They describe it as the ability to carry out tasks and operations in the shortest possible time. Kidd (1994) also recognizes that agile entities are fast moving, and Zhang (2011) considers quickness a characteristic of agile firms. In fact, agility as a business concept is centered around *speed* (Gunasekaran and Yusuf 2002). In one of the most frequently referenced articles on agile manufacturing, Gunasekaran (1998) identifies elements of swiftness (e.g., rapid partnership formation) as key agility enablers. A review of agility definitions (see Gligor and Holcomb 2012a) reveals that most conceptualizations of the construct place significant emphasis on *speed* (Iaccoca Institute 1991; Nagel and Dove 1991;

Gehani 1995; Gupta and Mittal 1996; Quinn et al. 1997; Narasimhan et al. 2006; Eshlaghy et al. 2008; Zhang 2011). *Swiftness* emerged as the fourth dimension of agility. It is defined as *the ability to implement decisions quickly*.

Flexibility

Sports science researchers consider flexibility to be a key element of agility. In their research on agility training, Sporis et al. 2010 highlight the impact of flexibility on agility. Research shows that agility performance can be improved through flexibility training (Wong et al. 2011). Military science research provides additional support for considering flexibility as an important element of agility. This body of literature recognizes that built-in flexibility is needed for agile military response (McNaughter et al. 2000; Atkinson and Moffat 2005).

Business research also suggests that a firm's response to changes depends on the flexibility of its supply chain tactics and operations (Hong et al. 1996; Christopher and Towill 2002; Swafford et al. 2006; Kumar and Deshmukh 2006; Swafford et al. 2008; Eshlaghy et al. 2010; Jacobs et al. 2011; Costantino et al. 2012). In a sports context, the athlete's mobility of joints (i.e., flexibility) controls the range of quick adjustments the athlete can perform. The type of direction change (agility) performed will be dependent on the flexibility of the specific body parts involved in the exercise. Similarly, a firm's supply chain operates within a specific range, and the firm's supply chain agility (i.e., adjustment of tactics and operations) will be constrained by that range. For example, the firm's supply chain cannot quickly produce more items than its fixed manufacturing capacity allows.

Flexibility has long been identified as a key agility dimension across manufacturing research. Agility as a business concept was first coined in relation to flexible manufacturing

systems (Nagel and Dove 1991). The idea of manufacturing flexibility was subsequently extended into a wider business context, and the concept of agility as an organizational trait was born (Christopher and Towill 2002). The role of flexibility in providing an agile response is highlighted within several agility definitions. Hong et al. (1996) define agility as flexibility and rapid response to market demands, while Eshlaghy et al. 2008 describe it as a model that provides flexibility. In one of the most referenced frameworks of manufacturing agility, Sharifi and Zhang (1999) propose flexibility to be one of the capabilities that an agile organization must possess. This perspective is supported by a number of empirical research articles within the manufacturing realm (Yusuf et al. 1999; Gunasekaran and Yusuf 2002; Kumar and Deshmukh 2006; Eshlaghy et al. 2010; Jacobs et al. 2011; Costantino et al. 2012).

Supply chain agility literature recognizes the role of flexibility in providing an agile response. Empirical research found a direct positive relationship between procurement and manufacturing flexibility and supply chain agility (Swafford et al. 2006). In their framework, Swafford et al. consider supply chain agility as an externally focused capability that is derived from flexibility (internally focused competency) in supply chain processes. Research also indicates that supply chain flexibility directly and positively impacts supply chain agility (Swafford et al. 2008). Other supply chain researchers recognize the role of flexibility. In their definition of supply chain agility, Li et al. (2008; 2009) consider flexibility to be a core aspect of the construct. Similarly this perspective finds support in a number of supply chain agility frameworks (Christopher 2000; Lin et al. 2006; Jain et al. 2008). The fifth dimension of agility, *flexibility,* is defined as the *ability to modify the range of tactics and operations to the extent needed.*

The firm supply chain agility construct

The examination of previous research also guided the classification of the agility dimensions into two higher-level categories: physical and cognitive. Research suggests that swiftness and flexibility represent the physical dimensions of firm supply chain agility; alertness, accessibility and decisiveness exemplify the cognitive dimensions of the concept. The cognitive dimensions of firm supply chain agility are related to information-processing and help firms determine what actions to take, while the physical dimensions are related to action-taking and enable firms to implement those actions (see Table 4.1).

Table 4.1

Summary and Classification of Firm Supply Chain Agility Dimensions

Dimension	Definition	Type
Alertness	Ability to quickly detect changes, opportunities and threats	Cognitive Dimensions
Accessibility	Ability to access relevant data	
Decisiveness	Ability to make decisions resolutely	
Swiftness	Ability to implement decisions quickly	Physical Dimensions
Flexibility	Ability to modify the range of tactics and operations to the extent needed	

In order to clearly establish the relationship between supply chain agility and its dimensions, it is important to determine whether the supply chain agility construct is reflective or formative. Three theoretical considerations can help distinguish formative models from reflective ones (Diamantopoulos and Winklhofer 2001; Coltman et al. 2008). The first

theoretical criterion is the nature of the construct. In reflective models the latent construct exists independent of the measures used, while in formative models the latent construct is determined as a combination of its indicators (Rossiter 2002; Borsboom et al. 2003). The second theoretical consideration pertains to the direction of causality between items and the latent construct. In reflective models variation in the construct causes variation in item measures, while in formative models variation in item measures causes variation in the construct (Bollen and Lennox 1991; Edwards and Bagozzi 2000; Diamantopoulos 2006). The third theoretical criterion considers the characteristics of the items used to measure the construct. In reflective models items are manifested by the construct and share a common theme. In formative models items define the construct and need not share a common theme (Rossiter 2002; Jarvis et al. 2003). Based on these theoretical considerations and consistent with prior research (i.e., Li et al. 2009), firm supply chain agility is operationalized as a second-order reflective construct with the first order factors of alertness, accessibility, decisiveness, swiftness and flexibility (Figure 4.1).

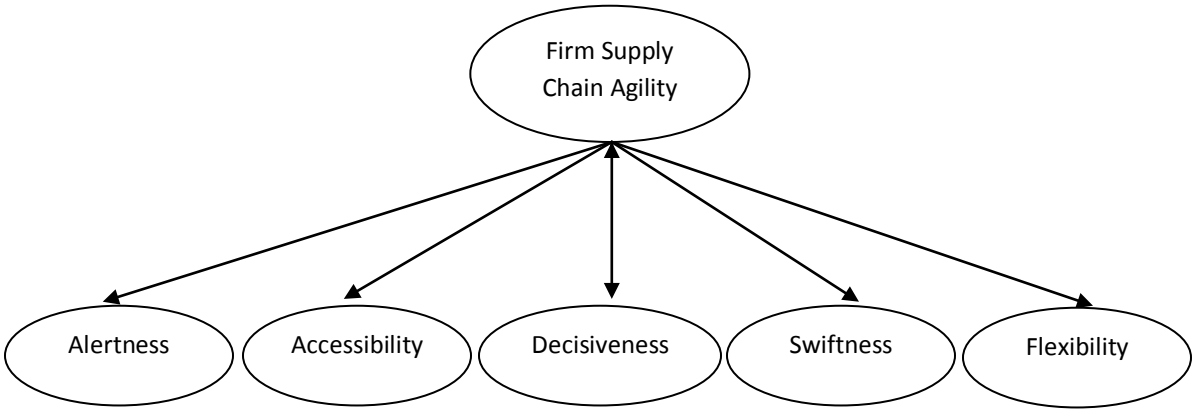

Figure 4.1

Dimensions of Firm Supply Chain Agility

METHOD

Following the identification of the dimensions of supply chain agility, the next phase of the research was to develop and test scales for each of the factors. The procedures used to develop and assess the validity of the agility scale are described below.

Scale development and survey design

Scale development followed procedures and guidelines recommended by Churchill (1979), DeVellis (1991), Hinkin (1995), Mentzer and Flint (1997), and Garver and Mentzer (1999). Each dimension of the second-order construct is measured by multi-item scales to increase reliability, decrease measurement error, ensure greater variability among the survey participants, and improve validity (Churchill 1979). Based on the literature review presented above, a pool of 33 items was generated to reflect each of the firm supply chain agility dimensions. In order to avoid scale proliferation, when possible existing scales were consulted (Bruner 2003).

Once the survey items were determined, the procedures suggested by Dillman (2007) for survey design were employed. All variables of interest were estimated through respondents' perceptual evaluation on a seven-point Likert scale: the response categories for each item were anchored by 1 (strongly disagree) and 7 (strongly agree).

Pretests of the supply chain agility measurement scale

The scale items were pretested to increase reliability, decrease measurement error, and improve the validity of the construct measurement (Dillman 2007). A Q-sort method was employed to achieve these goals (Moore and Benbasat 1991; Li et al. 2009). The pretest was

conducted in two stages: the first one was conducted with a sample of academics and the second with a sample of supply chain managers.

For the first phase of the pretest, a personalized email with a link to a Qualtrics-based Q-sort electronic document was sent to a group of 25 academic experts. The academic experts were selected based on their research interests, area of expertise and industry experience. The document contained the survey items for the supply chain agility construct, along with the definition of each construct dimension. Respondents were asked to place each item under the dimension they felt best represented the item. Further, the experts were asked to evaluate the items for face validity and provide qualitative feedback. Twenty responses were received, for an effective response rate of 80%. Based on the item placement ratios and the qualitative feedback received from academic experts, some survey items were revised, while others were selected for elimination. The purpose of the pilot test was to identify poor performing items rather than create highly purified scales (Defee et al. 2009).

Next, the resultant survey instrument was pretested using a random sample of supply chain managers drawn from a database of potential participants. The database of mid- and upper-level logistics, supply chain, and operations managers of North American companies was obtained from Dun & Bradstreet, a provider of business information. Potential respondents were carefully screened to ensure they had relevant knowledge of their firms' supply chain operations. A similar procedure to the one employed during the first phase of pretesting was employed. A personalized email, with a link to a Qualtrics-based Q-sort electronic document was sent to a sample of 272 managers. One hundred responses were received, resulting in a response rate of 27.2%. The managers represented a wide array of industry sectors including

manufacturing-general (16%), manufacturing-consumer products, transportation (15%), retail (9%) and twelve other sectors which accounted for the remaining 40% of respondents. Annual sales for the respondents' companies ranged from less than $250 million to greater than $9 billion. The modal group was represented by companies with revenues of less than $250 million (22%). Also, the level of professional work experience exceeded 20 years for 49% of the respondents.

The results of the second Q-sort pretest indicated that, except for four items, item placement ratios exceeded the recommended level of 0.70 (Moore and Benbasat 1991) considered acceptable for exhibiting content validity, while the inter-judge agreement exceeded the recommended 0.65 value (Perreault and Leigh 1989). Based on these results, and the qualitative feedback received from the managers, six survey items were revised and one was eliminated. Ultimately, six items were used to measure *alertness*, seven items to measure *accessibility*, six items to measure *decisiveness*, five items to measure *swiftness*, and six items to measure *flexibility*. These items were used for the final model testing.

Data collection and sampling for final model testing

The unit of analysis for the research is the firm, and the preferred target respondents were senior-level managers with knowledge of supply-chain processes and activities, and direct involvement in operational and strategic decision-making. Data was gathered using a non-experimental survey methodology (Kerlinger and Lee 2000). Specifically, the research employed an internet survey to collect the necessary data for model testing. The web-based survey approach is appropriate because the population of interest is business, and coverage issues are not present due to high rates of computer use and the large sample size (Dillman 2000).

Purposive sampling was employed in hopes of achieving a moderate level of external validity and to contribute to the generalizability of results (Cook and Campbell 1979). Potential respondents were identified from two sources. The first source of potential participants was a database of supply chain managers that comprised the mailing list of the supply chain management program of a large public university. The database contained contact information for more than 3,000 managers (name, phone number, e-mail and title) from U.S.-based companies in a diverse set of industries. An email was sent to all contacts in the database requesting participation in the study. The Qualtrics software indicated that the email was received and opened by 285 respondents, confirming that correct/updated contact information existed for these managers. Therefore, this sample of 285 respondents was considered for final survey testing. In order to increase response rate, participants were offered an executive summary of the research findings and entered into a raffle for the chance to win $100.

The second source of potential participants was selected from the panel members of SurveyMonkey, a large third party marketing firm that specializes in survey data collection. SurveyMonkey provided contact information for 1,135 senior-level managers of diverse backgrounds, with knowledge of supply-chain processes and activities, and direct involvement in operational and strategic decision-making were prequalified to participate in the study. While participants were not provided any direct financial incentives, SurveyMonkey pledged to donate $0.50 to the charity of the respondents' choice, and enter the respondents into a raffle for the chance to win $100.

Potential respondents from both databases (university supply chain program and SurveyMonkey) were pre-qualified using the procedures suggested by Dillman (2000) and

Kerlinger and Lee (2000). Following the purification of the measurement instrument, the main survey test was sent to the sample of 285 potential respondents selected from the database of the university's supply chain program, and the sample of 1135 pre-qualified SurveyMonkey panel members. Two reminders spaced one week apart followed the initial email to the sample of university's supply chain members. Once all the data collection methods had been concluded, 141 usable responses were received from the sample of the university supply chain program contacts for a response rate of 49.5%. Five hundred and thirty usable responses were received from the SurveyMonkey panel members for a response rate of 46.7%. No reminder was sent to the SurveyMonkey panel members because of the initial high response rate. Responses from the two samples were compared using ANOVA and no significant differences were found. Combined, the two samples generated a total of 671 usable responses which provided adequate statistical power to perform the necessary analysis. The demographics information for the final group of respondents is presented in Table 4.2.

For the survey sent to the sample of university supply chain program contacts, non-response bias was initially assessed by comparing first and second waves of survey responses using ANOVA (Armstrong and Overton 1977). Non-response bias was also examined using the guidelines suggested by Mentzer and Flint (1997). A random sample of 30 non-respondents was contacted and asked to respond to five non-demographic questions. Specifically, the five questions addressed the construct of firm supply chain agility. A similar procedure was employed to test non-response bias for the SurveyMonkey panel members: a random sample of 30 non-respondents was contacted and asked to respond to five non-demographic

Table 4.2

Demographics for the Final Test Sample

Level of Professional Work Experience	Percentage	Total Company Annual Sales	Percentage	Type of Industry	Percentage
<1 year	4%	<$250 million	18%	Energy/Chemical/Mining	2%
1-3 years	3%	$250 million-$500 million	12%	Communications/Media/ Entertainment	3%
3-5 years	10%	$500 million-$1 billion	10%	Retail	18%
5-10 years	9%	$1-$2 billion	17%	Manufacturing-General	19%
10-15 years	10%	$2-$3 billion	13%	Manufacturing-Consumer products	15%
15-20 years	12%	$3-$5 billion	10%	Manufacturing-Aerospace/defense	4%
20+ years	52%	$5-$9 billion	8%	Manufacturing-High technology	4%
		>$9 billion	12%	Energy/Chemical/Mining	1%
				Financial Services/Insurance	2%
				Life Sciences-Pharmaceuticals	3%
				Life Sciences-Medical devices	3%
				Health Managed Care	2%
				Transportation Service Provider	8%
				Other	16%
Total	**100%**		**100%**		**100%**

questions. For both samples (university supply chain program and SurveyMonkey panel members), no statistical difference was found between the answers to these questions of respondents and non-respondents. Therefore, non-response bias is not considered a problem with the data.

Scale purification

Prior to purification of the measurement items, basic statistical analyses of the collected data were performed, such as examination of mean, minimum and maximum values, standard

deviation, and normality tests (i.e., skewness and kurtosis). The primary approaches for measurement item purification included multiple iterations of confirmatory factor analysis (CFA), with the maximum likelihood estimation (MLE) method that iteratively improves parameter estimates to minimize a specified fit function. In addition to the statistical analyses, theoretical assessment was made prior to final deletion of any measurement items. When modifying the model, indicators such as offending estimates, squared multiple correlations, standardized residual covariances, and modification indices were considered. In the category of offending estimates a check was performed for negative error terms, standardized coefficients exceeding or very close to 1.0, and very large standard errors. Squared multiple correlations (SMC) were reviewed as well to locate any relatively small SMC values that indicate the portion of a variable's variance that is accounted for by its predictor is minimal at best (Joreskog and Sorbom 1989). Any SMC values of 0.20 or less were put to the test of deletion. Standardized residuals are the differences between the observed covariance and the estimated covariance matrix, and significant residuals (greater than |2.58| which is statistically significant at the 0.05 level) indicate a substantial prediction error for a pair of indicators (Hair et al. 1998).

The modification index (MI) is a measure of whether an item loads on multiple factors. For the value of the MI, a coefficient value equal or greater than 3.85 indicates that chi-square can be statistically significantly reduced with the estimation of the coefficient. If a more conservative approach is taken, a value of MI equal to or greater than ten would recommend an item for deletion (Fassinger 1987). The more conservative value of 10 was used for this research based on the assumption that most of the multi-loaded items had already been screened out in the pretest. Following the purification of the measurement instrument, all 30

items that were used to measure the dimensions of firm supply chain agility were retained including: six items used to measure *alertness*, seven items to measure *accessibility*, six items to measure *decisiveness*, five items to measure *swiftness*, and six items to measure *flexibility*.

Analysis of scale measurement reliability and construct validity

Reliability was assessed using Cronbach's Coefficient Alpha, with a rule that an alpha above .70 indicates good correlation between the item and the true scores, and lower alpha levels suggest that the sample of items is a poor indicator of the construct (Churchill 1979). Also, because coefficient alpha tends to underestimate scale reliability and has several limitations, the guidelines suggested by Garver and Mentzer (1999) were followed as well. If the construct reliability measure is greater than 0.70 and the variance extracted is 0.50 or greater, then the support for reliability is adequate. Results in Table 4.3 indicate that for all dimensions coefficient alpha and construct reliability exceed the recommended value of .70, however, the variance extracted for the dimensions of *accessibility* and *flexibility* were at 0.487, and 0.475, respectively.

Construct validity was examined through the adequacy of the model's fit and both convergent validity and discriminant validity. Evaluating the overall model fit using the CFA technique is the first step in assessing construct validity. Goodness-of-fit criteria examine how well the data fit the proposed model. A model is considered to be satisfactory if the comparative fit index (CFI) is greater than 0.90, the goodness-of-fit index (GFI) is greater than 0.90, and the root mean square error of approximation (RMSEA) is less than 0.08 (Byrne 1998). Results indicate that the measurement model has a satisfactory fit with a *Chi-square* of 1941.194 and 400 degrees of freedom, CFI=0.886, RMSEA=0.077, and GFI=0.803.

Table 4.3

Reliability and Convergent Validity Results

Scale/Item	Cronbach Alpha for Scale	Alpha if Item Deleted	CR	Item-to-Total Correlation	Mean	SD	Item Loadings	Average Variance Extracted
Alertness	.899		.898					.509
A1		.881		.725	3.23	1.236	.761	
A2		.883		.714	2.97	1.169	.781	
A3		.878		.745	3.13	1.262	.791	
A4		.880		.729	3.04	1.234	.799	
A5		.879		.739	3.13	1.276	.773	
A6		.885		.701	3.26	1.237	.726	
Accessibility	.868		.868					.488
B1		.851		.625	2.95	1.168	.751	
B2		.843		.695	2.91	1.142	.785	
B3		.847		.658	3.15	1.346	.657	
B4		.843		.691	2.90	1.176	.780	
B5		.853		.619	3.19	1.358	.644	
B6		.847		.660	2.89	1.176	.668	
B7		.860		.561	2.83	1.272	.577	
Decisiveness	.868		.880					.552
C1		.851		.725	2.87	1.168	.786	
C2		.850		.729	2.96	1.208	.785	
C3		.846		.753	2.94	1.191	.805	
C4		.863		.654	2.85	1.219	.674	
C5		.870		.612	2.76	1.223	.665	
C6		.865		.639	3.06	1.185	.732	
Flexibility	.841		.843					.475
E1		.808		.654	2.93	1.273	.687	
E2		.802		.689	2.85	1.210	.772	
E3		.818		.606	2.71	1.291	.686	
E4		.832		.635	3.21	1.310	.637	
E5		.810		.647	2.59	1.164	.681	
E6		.820		.591	2.78	1.236	.665	
Swiftness	.882		.882					.598
D1		.861		.700	3.08	1.276	.780	
D2		.850		.570	3.13	1.310	.788	
D3		.861		.522	3.23	1.274	.716	
D4		.852		.545	3.03	1.331	.790	
D5		.860		.509	2.95	1.244	.791	

Convergent validity was judged by assessing the overall fit of the measurement model, the magnitude, direction, and statistical significance of the estimated parameters between the latent variables and their indicators, with 0.70 being the value of substantial magnitude of the

parameter estimate (Garver and Mentzer 1999). Results in Table 4.3 suggest convergent validity is satisfactory. Convergent validity can further be assessed in terms of the degree to which the subscales are correlated. As shown in Table 4.4, the correlations between the dimensions are significantly different from zero ($p<0.05$). This suggests that the five dimensions are all measuring some aspect of the same construct.

Table 4.4

Correlations Table

	Alertness	**Accessibility**	**Decisiveness**	**Swiftness**	**Flexibility**
Alertness	1				
Accessibility	.920	1			
Decisiveness	.941	.922	1		
Swiftness	.985	.914	.994	1	
Flexibility	.868	.920	.923	.911	1

Discriminant validity was first assessed using the average variance extracted method (Fornell and Larcker 1981). The variance extracted measures for the five dimensions (alertness, accessibility, decisiveness, swiftness, and flexibility) were 0.509, 0.488, 0.552, 0.598, and 0.475, respectively. A check was performed to determine whether the average variance extracted for each pair of constructs was greater than their squared correlation. As Table 4.4 indicates, the dimensions are highly correlated, ranging from 0.868 to 0.994. Therefore, this test did not provide evidence of discriminant validity. Discriminant validity was further assessed by running a series of nested CFA model comparisons in which the covariance between each pair of constructs (one pair at a time) was constrained to one (Anderson and Gerbing 1988; Bagozzi and Yi 1988). If the chi-square difference test is significant when all of the correlations between

the constructs are fixed to one for the theoretical model, and for the measurement model allowing the two constructs to correlate freely, then the constructs are deemed to discriminate adequately. Table 4.5 indicates that all constructs passed this test, however, this test was not considered sufficient to establish discriminant validity given the correlations among the constructs.

Table 4.5

Chi-square Difference Test to Assess Discriminant Validity

	Accessibility	**Decisiveness**	**Swiftness**	**Flexibility**
Alertness (X^2_{diff})	128.489	68.069	41.861	150.759
Accessibility(X^2_{diff})		103.763	120.099	67.401
Decisiveness(X^2_{diff})			25.03	80.68
Swiftness(X^2_{diff})				129.996

Notes: $p<0.001$; $df_{diff}=4$

Due to a lack of satisfactory discriminant validity, the measurement items for each of the proposed dimensions were further refined using theoretical considerations. Specifically, a panel of experts examined the definition of each construct and compared it to its assigned measurement items as a post hoc test to identify items that did most precisely fit the definition. Following this process, 14 of the 30 items for FSCA were retained. The final measurement items are presented in Appendix 4.A. The model featuring the remaining items for the five dimensions of FSCA were then subjected to the discriminant validity procedures described above. The results of these tests continued to provide inadequate evidence of discriminant validity among the five dimensions. Therefore, the data provided insufficient evidence to model FSCA as a second order construct reflecting five independent dimensions. Since the five

constructs emerged as dimensions of FSCA, but not distinct from each other, FSCA was determined to be a first order reflective construct tapping five domains of agility.

Final model results

Results of analysis of the measurement model portraying FCSA as a first order construct indicate adequate fit with a *Chi-square* of 481.102 and 77 degrees of freedom, CFI=0.930, RMSEA=0.090, and GFI=0.897. Although it can't be inferred that the five proposed FSCA dimensions are *distinct* from each other, the results suggest that in aggregate the five concepts identified in the research represent domains of FSCA. The identification of the five dimensions of a firm's supply chain agility enables the development of a comprehensive definition as follows: *A firm's supply chain agility is manifested through the firm's cognitive and physical capabilities that enable the firm to quickly detect changes, opportunities and threats (alertness), access relevant data (accessibility), make resolute decisions on how to act (decisiveness), quickly implement decisions (swiftness) and modify its range of supply chain tactics and operations to the extent needed to implement the firm's strategy (flexibility).*

RESULTS DISCUSSION

This research contributes to theory building by addressing the ambiguity surrounding the dimensions and definition of *firm supply chain agility*. It expands on Li et al. (2009) and Braunscheidel and Suresh's (2009) work by fully exploring the construct's multidimensionality. Alertness, accessibility, decisiveness, swiftness, and flexibility were examined as potential *firm supply chain agility* dimensions. Although the multidisciplinary literature reviewed indicated

these constructs as potential dimensions of FSCA, the results of this research didn't provide sufficient evidence to consider alertness, accessibility, decisiveness, swiftness, and flexibility as *distinct* dimensions of FSCA. The final measurement model displayed adequate convergent validity indicating that the suggested dimensions do capture the variance in the FSCA construct. However, the lack of satisfactory evidence of discriminant validity indicates that while these are indeed dimensions of FSCA, they might not be *distinct* from one another.

One plausible explanation for the lack of discriminant validity among the five FSCA dimensions can be found in the newly developed measurement items. Measurement items for four out of the five dimensions used statements addressing the firm's response to changes, opportunities, and threats. For example, one item intended to measure *alertness* states "We can quickly detect **changes** in our environment", while another used to measure *accessibility* reads "My company can access the information it needs to deal with **changes** in its environment". In this example, the use of the word "changes" in both statements could have caused the high inter-item correlation, and therefore constitute a possible explanation for the lack of satisfactory discriminant validity among the suggested dimensions.

It can be concluded that future research is needed to further examine whether alertness, accessibility, decisiveness, swiftness, and flexibility are indeed *distinct* from one another. Identification of the 14 elements of FSCA did enable the development of a comprehensive definition to help address definitional inconsistencies associated with the construct and provide guidance for further theoretical testing of the concept. This is an important contribution as definitional ambiguities surrounding a concept pose a threat to its

usefulness as a theoretical construct (Luthar et al. 2003). Another key contribution is the development of a comprehensive FSCA measurement instrument tapping the five dimensions.

Prior research has used the terms agility and flexibility interchangeably (Giachetti et al. 2003; Li et al. 2008; Almahamid et al. 2010), which makes theory building problematic. The confusion was in part generated by the fact that both terms were introduced as a means for organizations to deal with changes. Consistent with the literature reviewed in the previous sections, this research suggests that the two terms are distinct concepts, with flexibility being a dimension of agility. This differentiation was needed to gain a deeper understanding of agility and how the concept can be positioned against the backdrop of research addressing related business phenomena. For managers, the distinction illustrates the specific role each construct (i.e., agility and flexibility) has in assisting organizations deal with changes.

Based upon the sports and life sciences literature, this research posits that *firm supply chain agility* dimensions can be classified into two categories: cognitive and physical. The cognitive dimensions (alertness, accessibility, decisiveness) are related to information-processing, while the physical dimensions (swiftness, flexibility) are related to action-taking. For managers, the findings offer a clear distinction between the two types of capabilities that a firm must possess to achieve the desired supply chain agility level. Too often the focus of managerial attention is on physical attributes of business initiatives at the expense of cognitive and behavioral dimensions.

Managers can use the comprehensive list of dimensions examined in this research to determine what aspects of their operations and tactics should be improved to enhance the firm's supply chain agility. By evaluating their organization's approaches to the five dimensions

of supply chain agility, managers can identify aspects of supply chain management that need to be addressed to increase the firm's supply chain agility. For instance, it could be the case than an organization excels at quickly identifying changes in its environment (i.e., alertness), but has suboptimal decision making processes, which prevents it from making resolute decisions (i.e., decisiveness). Once managers identify weaknesses associated with either one of the five dimensions, corrective actions can be taken to reduce or eliminate these vulnerabilities, and increase the firm's level of supply chain agility.

LIMITATIONS AND FUTURE RESEARCH

Limitations inherent to any single article can be addressed through future research. One plausible explanation for the lack of discriminant validity among the five FSCA dimensions could be due to the use of measurement items addressing the firm's response to changes, opportunities, and threats for four out of the five dimensions. Future research could help establish if eliminating those items from some of the dimensions would lead to the development of a five-dimensional measurement instrument with adequate discriminant validity. In order to establish statistical generalizability, the research presented in this paper needs to be replicated with new samples from the population. A study can only address statistical generalizability by not drawing conclusions beyond the scope of its sample (Mentzer and Flint 1997). While, this research sought generalizability across multiple industries, future research could focus on single industries.

The measurement instrument developed in this research should be tested in a nomological model of antecedents and outcomes, for instance one examining strategic-level FSCA antecedents and performance-related outcomes. This would further validate the current research and increase the degree of confidence in the scale's validity and reliability. Lastly, as is the case with most supply chain survey research, the constructs of interest were evaluated based on the perception of a single party involved in a specific supply chain. Future research using multiple dyads or triads within various supply chains could address this limitation.

CHAPTER 5 - ARTICLE 2: AN EXPLORATION OF THE ANTECEDENTS AND CONSEQUENCES OF FIRM SUPPLY CHAIN AGILITY

INTRODUCTION

Agility has been identified as one of the most salient issues of contemporary supply chain management (Lee 2004). Despite its importance, there has been limited theory development in the firm supply chain agility area. The antecedents of firm supply chain agility, defined as the firm's ability to quickly adjust its supply chain tactics and operations (Gligor and Holcomb 2012b), have been primarily addressed at an operational level. Gligor and Holcomb (2012b) emphasized that more research is needed to identify the firm supply chain agility strategic-level antecedents. We address this by expanding on the work of Braunscheidel and Suresh (2009) who explored the role of different managerial orientations in achieving supply chain agility. The current research hypothesizes that market orientation has a direct impact on firm supply chain agility. Further, it is not enough to be market oriented to achieve a high level of supply chain agility; rather, a supply chain orientation needs to be developed as well. As a result, one key contribution of this research is theory expansion through exploration of firm supply chain agility strategic-level antecedents.

Although the benefits of agility have been widely recognized across a variety of domains (Christopher 2000; Van Oyen et al. 2001; Wilson and Doz 2011; Zhang 2011), little empirical research addresses the impact of firm supply chain agility on performance (e.g., Swafford et al. 2008; Gligor and Holcomb 2012b). Scholars have issued research calls for an in-depth understanding of the performance outcomes of firm supply chain agility and accentuated the

need to empirically examine such outcomes from an efficiency and effectiveness perspective (Gligor and Holcomb 2012a). Our study responds to such calls, and further investigates the impact of firm supply chain agility on the firm's financial performance using secondary, Compustat data. Thus, this research further contributes to theory development by providing a better understanding of how firm supply chain agility impacts firm performance.

The current research builds on the theoretical base of the Resource Based View (RBV) of the firm, the Relational View (RV) theory, and the Strategy-Structure-Performance (SSP) paradigm. Combined, these theoretical lenses drive the research hypotheses generation and facilitate the theoretical model development. The rest of the paper is organized as follows. We first present the theoretical background and the hypotheses formulation process. This is followed by the section introducing the details of the empirical approach. Next, the results of our analyses are discussed. Finally, we discuss the study's limitations and implications, and suggest areas of further research.

THEORY AND HYPOTHESES DEVELOPMENT

This section presents the research model and the theoretical underpinnings that guided hypotheses development.

Environmental uncertainty-strategic orientations link

According to SSP, a firm's strategy, created in consideration of external environmental factors, drives the development of organizational structure and processes (Galbraith and Nathanson 1978; Miles and Snow 1978). The concept of environmental uncertainty is of interest to this research as it represents the rate of change and degree of instability in the

environment (Dess and Beard 1984). Research indicates a limited need for agility when operating in environments characterized by low uncertainty (Lee 2002; Swafford et al. 2006; Sebastiao and Golicic 2008). Therefore, it is this study's premise that environmental uncertainty (ENVU) indirectly impacts the strategic development of firm supply chain agility (FSCA) via the firm's market orientation (MO) and supply chain orientation (SCO). These two types of firm orientations are discussed next.

MO has been described as the organization-wide generation, dissemination, and responsiveness to market intelligence (Kohli and Jaworski 1990). In essence, market oriented firms seek to understand customers' expressed and latent needs and develop superior solutions to those needs (Slater and Narver 1999). MO can be viewed as a continuum, with firms exhibiting varying degrees of this propensity (Braunscheidel and Suresh 2009).

The development of a MO is an important strategic choice (Qu and Ennew 2008) and numerous research articles have emphasized the importance of a fit between strategy and business environment (Snow and Hrebniak 1980; Hambrick 1983; Mckee et al. 1989). Similarly, Kohli and Jaworski (1990) proposed that firms operating in markets characterized by low turbulence have a lower need to be market oriented because those firms only cater to a fixed set of customers with stable preferences. In contrast, if customers' expectations are less stable, firms must understand the changing customer preferences and adjust their offering to match them. It is important to emphasize that Kohli and Jaworski (1990) do not suggest that a MO is not needed in environments characterized by low uncertainty, but rather that it is less vital. Qu and Ennew (2008) also provide empirical evidence for the positive relationship between the business environment and MO. Thus, it is proposed that:

H1: There is a direct and positive relationship between a firm's degree of ENVU and its level of MO.

Research has shown that MO is not sufficient for market competitiveness (Han et al. 1998; Min et al. 2007), but SCO, in combination with MO can create competitive advantage. SCO, defined as "the recognition by an organization of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain" (Mentzer et al. 2001, p. 11), emphasizes the strategic awareness and embracing of supply chain management (SCM) within an individual supply chain firm. SCO emerges as a necessary antecedent to effective SCM (Min and Mentzer 2004).

To select a supply chain strategy, the nature of the demand and supply for the product must be considered (Fisher 1997). Other research has highlighted the importance of matching supply chain strategies with market conditions and product characteristics (Christopher and Towill 2002; Lee 2002). Also, different supply chain strategies require different approaches to the management of supply chains (Christopher et al. 2006). Considering that SCM is the sum of all the management actions undertaken to execute the firm's SCO (Mentzer et al. 2001), firms that strategically approach SCM should consider the level of ENVU when developing a SCO. Research on nascent technology firms operating in dynamic environments further supports the contention that the primary strategic orientation for managing a supply chain should be developed in consideration of environmental characteristics (Sebastiao and Golicic 2008). A high level of ENVU requires an increased focus on SCM to successfully respond to market needs (Sebastiao and Golicic 2008). For a firm to survive, a certain degree of fit between its

environment and its strategy is required (Chandler 1962; Rumelt 1974). Therefore, the following hypothesis is put forth:

H2: There is a direct and positive relationship between a firm's degree of ENVU and its level of SCO.

MO-FSCA link

The RBV provides support for considering MO as a direct antecedent to FSCA. According to RBV, firms that are able to accumulate resources and capabilities that are rare, valuable, non-substitutable, and difficult to imitate will achieve a competitive advantage over competing firms (Rumelt 1984; Wernerfelt 1984; Barney 1991). MO is a rare resource (Hunt and Lambe 2000) which, when combined with other resources (e.g., SCO), can contribute to the creation of a unique set of resources that can give rise to a positional advantage for firms (Hult and Ketchen 2001). It is the current research's premise that FSCA is one of the unique resources resultant from combining MO with SCO.

The strategy-structure-performance (SSP) paradigm also provides theoretical support for considering MO a direct antecedent to FSCA. MO is considered a firm strategy (Taghian 2010) that drives the development of processes and capabilities needed to respond to customers' expressed and latent needs (Slater and Narver 1999). Supply chain agility has been recognized as a capability that firms must possess in order to provide a real time response to customers' unique and changing needs (Christopher 2000; Van Hoek et al. 2001; Yusuf et al. 2004). Therefore, as MO increases so will the recognition and development of increased FSCA capabilities to respond to customer needs.

The literature on supply chain agility offers additional support linking MO to FSCA. Before a firm can respond to changes in demand, it must first identify those changes (Christopher 2000). The ability to read customer demand in real time has been recognized as a necessary condition for agility by a plethora of research (Goldman et al. 1995; Sharifi and Zhang 1999; Christopher 2005; Lin et al. 2006; Agarwal et al. 2007; Jain et al. 2008; Li et al. 2008; 2009; Inman et al. 2011; Vinodh and Prasanna 2011; Zhang 2011; Tseng and Lin 2011; Lu and Ramamurthy 2012; Tallon and Pinsonneault 2011). MO implies organizational-wide generation of market intelligence (Kohli and Jaworski 1990). Therefore, we can infer that possessing a MO influences FSCA as it facilitates detection of changes in the environment. Hence, the following hypothesis is considered:

H3: There is a direct and positive relationship between a firm's level of MO and its level of supply chain agility.

SCO-FSCA link

SCO is a strategic resource that is rare, valuable, non-substitutable, and difficult to imitate (Mentzer et al. 2001; Mello and Stank 2005). Therefore, according to RBV, supply chain oriented firms can achieve a competitive advantage over competing firms (Rumelt 1984; Wernerfelt 1984; Barney 1991). Within the RBV framework, FSCA can be considered a capability that results from being supply chain oriented and helps attain a competitive advantage.

Supply chain research distinguishes between the strategic and structural aspects of SCO (Esper et al. 2010). The SCO strategy emphasizes a systems approach to viewing the supply chain holistically rather than as constituent parts; it seeks to integrate, synchronize and

converge intra-firm and inter-firm operational and strategic capabilities (Min et al. 2004). Within the strategy-structure-performance paradigm, the strategic aspect of SCO is considered to drive the development of organizational structure and processes (Esper at al. 2010). Part of structural development for firms is to determine how to allocate resources to create capabilities and how sets of capabilities should be coordinated and organized (Stank et al. 2005). Consequently, the SSP paradigm provides additional theoretical support for considering SCO an antecedent to the development of the FSCA capability.

Firms cannot develop supply chain agility in isolation from their supply chain members. Members of the supply chain must be capable of rapidly aligning their collective capabilities to respond to changes in market and customer demand (Gligor and Holcomb 2012a). The key to providing an agile response is inter-firm cooperation (Goldman and Nagel 1993) and supply chain members must be linked together as a network (Christopher 2000). Firms that can better manage their supply chains will achieve a higher level of FSCA (Lin et al. 2006; Jain et al. 2008). SCO is needed for SCM (Min and Mentzer 2004; Min et al. 2007), and SCM is a *sine qua non* condition for developing FSCA (Ketchen and Hult 2007; Li et al. 2008; 2009). As a result, the following hypothesis is proposed:

H4: There is a direct and positive relationship between a firm's level of SCO and its level of supply chain agility.

MO-SCO link

While not the focus of this research, the relationship between MO and SCO is investigated to enhance the explanatory power of the proposed theoretical model. Research indicates that organizational learning, an intricate part of MO, is accomplished through external

partners, such as suppliers, distributors, and customers (Slater and Narver 1995). Within such alliances, partners seek to discover and acquire knowledge not available to competitors (Lei et al. 1997). This suggests that MO cannot be isolated from relationships with suppliers and customers (Webster 1992) as it drives the development of a systems approach (i.e., SCO) within the firm (Min et al. 2007).

In addition to customers, markets also include members of the supply chain along with other exogenous factors that impact customer needs and preferences (Kohli and Jaworski 1990). As such, market-oriented firms must understand their consumers' behavior and their supply chain members' as well (Min et al. 2007). Market-oriented firms should be motivated to be more supply chain oriented to access information from supply chain partners (Min et al. 2007). MO was also found to impact the other partners' trust, commitment and cooperative norms (Siguaw et al. 1998), which are conceptualized by Min and Mentzer (2004) as elements of SCO. Market oriented firms possess a knowledge base that facilitates the recognition of the systemic, strategic implications of managing the various flows in a supply chain (Min et al. 2007). Further, Min et al. (2007) provided empirical support that MO directly and positively impacts SCO. So, it is proposed that:

H5: There is a direct and positive relationship between a firm's level of MO and its level of SCO.

FSCA-firm performance link

Performance measurement is an analysis of both efficiency and effectiveness in accomplishing a given task (Mentzer and Konrad 1991; Fugate et al. 2009). Efficiency is defined as the ratio of resources utilized against the results derived, and referred to in this research as

cost efficiency; effectiveness is defined as the extent to which customer-related objectives have been met, and referred to as customer effectiveness (Mentzer and Konrad 1991). The overall level of financial performance is also evaluated in this research.

The SSP paradigm supports the link between FSCA and organizational performance. It suggests that a firm's supply chain agility developed in consideration of the firm's strategy (e.g., combination of MO strategy and SCO strategy) can lead to organizational performance superior to that of competitors that lack the same degree of fit (Miles and Snow 1984). While a firm's internal SCO and MO can guide the development of FSCA, this capability cannot be created in isolation from the firm's supply chain members (Gligor and Holcomb 2012b). Since part of strategically creating supply chain agility is the development of idiosyncratic linkages with supply chain partners, FSCA can also be considered a source of competitive advantage within the RV framework (Dyer and Singh 1998; Mesquita et al. 2008).

Research has consistently associated agility with effective SCM (Christopher 2000; Ketchen and Hult 2007; Li et al. 2008). Agility has been referred to as an effective response to change (Mason-Jones and Towill 1999; Dove 2005; Holsapple and Jones 2005), and as effective, flexible accommodations of customer demand (Christopher 2000). Also, Ketchen and Hult (2007) suggest that agility is a criterion for gauging a supply chain's effectiveness. However, no research has empirically tested the relationship between FSCA and firm effectiveness. To address this limitation, the following hypothesis is considered:

H6: There is a direct and positive relationship between a firm's level of supply chain agility and its customer effectiveness.

Agility has been traditionally considered the opposite of lean, which has been linked to cost efficiencies (Christopher 2000; Goldsby et al. 2006). Supply chain researchers characterize lean management as concerning the minimization of waste and, therefore, liken this to a strategy focused on efficiency (Christopher and Towill 2002; Randall et al. 2003; Christopher et al. 2006; Sebatiao and Golicic 2008). This would suggest that agility is about availability, flexibility, and the ability to react quickly to changes, and it has less to do with efficiencies. However, supply chain research provides no empirical evidence to indicate that agile supply chains cannot be efficient as well.

There are divergent perspectives across supply chain researchers regarding the relationship between agility and efficiency. Lee (2004) argues that most supply chains cope with sudden and unexpected changes in demand and supply by playing speed against costs, but agile ones respond quickly and cost efficiently. Therefore, he proposes that agile supply chains are not only effective, but efficient as well. Tseng and Lin (2011) suggest that embracing agile strategies has several benefits for companies, including quick and efficient reaction to changing market requests. These authors recognize that agile entities can also be efficient. Manufacturing (Fliedner and Vokurka 1997; Zhang and Sharifi 2000; Gunasekaran and Yusuf 2002) and sports science (Miller et al. 2006) research also acknowledge the efficiency aspect of agility. Consequently, in order to empirically examine the relationship between FSCA and efficiency, the following hypothesis is put forth:

H7: There is a direct and positive relationship between a firm's level of supply chain agility and its cost efficiency.

Finally, consistent with literature on performance measurement (e.g., Mentzer and Konrad 1991; Brewer and Speh 2000; Lambert and Pohlen 2001), we propose that a firm's cost efficiency and customer effectiveness will positively impact its financial performance. Research suggests that as processes become more efficient and effective, financial performance improves as well (Lambert and Pohlen 2001). For example, Fugate et al. (2009) empirically established the link between logistics operations efficiency and effectiveness and organizational financial performance. As a result, the following hypotheses are suggested:

H8: There is a direct and positive relationship between a firm's customer effectiveness and its financial performance.

H9: There is a direct and positive relationship between a firm's cost efficiency and its financial performance.

A theoretical model, shown in Figure 5.1, displays the hypothesized relationships among the constructs of ENVU, MO, SCO, FSCA, and the dimensions of firm performance.

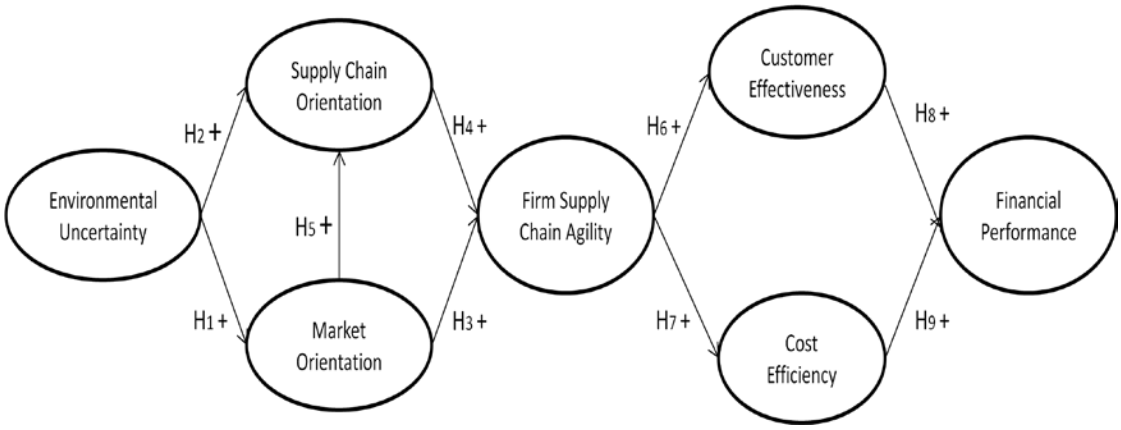

Figure 5.1

Theoretical Model of Firm Supply Chain Agility

METHOD

Subsequent to the development of the firm supply chain agility model, measurement scales were developed for the constructs of interest. The procedures used to assess the validity of the measurement scales and to test the theoretical model are described below.

Scale development and survey design

For scale development, procedures and guidelines recommended by Churchill (1979), DeVellis (1991), Mentzer and Flint (1997), and Garver and Mentzer (1999) were followed. Each construct was measured by multiple items to increase reliability, decrease measurement error, ensure greater variability among the survey participants, and improve validity (Churchill 1979). Existing scales were consulted when possible to avoid scale proliferation (Bruner 2003).

Consistent with previous FSCA operationalizations (i.e., Li et al. 2009) and scale development theoretical considerations (Coltman et al. 2008; Diamantopoulos and Winklhofer 2001). As described in Chapter 4, FSCA is operationalized as a second-order reflective construct. Through a multidisciplinary literature review (i.e., social, military, sports, and business science) five FSCA dimensions were identified: alertness, accessibility, decisiveness, swiftness and flexibility (Christopher et al. 2004; Sheppard and Young 2006; Dekker 2006; Lin et al. 2006; Sheffer 2006; Agarwal et al. 2007; Jain et al. 2008; Bradshaw et al. 2010; Eshlaghy et al. 2010; Jacobs et al. 2011; Zhang 2011; Vinodh and Prasanna 2011; Tseng and Ling 2011; Lu and Ramamurthy 2012; Costantino et al. 2012; Gligor and Holcomb 2012b). Thus, a firm's supply chain agility is manifested through the firm's capabilities that enable the firm to quickly detect changes, opportunities and threats (alertness), access relevant data (accessibility), make

resolute decisions on how to act (decisiveness), quickly implement decisions (swiftness), and modify its range of supply chain tactics and operations to the extent needed to implement the firm's strategy (flexibility). MO was also operationalized as a second-order reflective construct, with the first order factors of *intelligence generation*, *intelligence dissemination*, and *response to intelligence* (Kohli and Jaworski 1990; Min et al. 2007). Consistent with SCM literature, the remainder model constructs were operationalized as first order constructs (Fugate et al. 2009; Tachizawa and Gimenez 2010; Liang et al 2010; Kirchoff 2011; Wang et al. 2011).

Following the generation of survey items, the guidelines proposed by Dillman (2000) for survey design were employed. All variables of interest were estimated through respondents' perceptual evaluation on a seven-point Likert scale: the response categories for each item were anchored by 1 (strongly agree) and 7 (strongly disagree). In addition, respondents were assured of anonymity, and given the option to provide their firm name, so objective measures could be obtained on financial data. Data was available in the Compustat database on 146 of the participants that provided their firm names. Four objective indicators (return on sales, return on assets, return on investment, and profit margin) obtained via Compustat were used to evaluate performance for those companies. There was a positive, significant correlation ($p<.01$) between the Likert-scale measures and Compustat obtained data of .417 for ROS, .425 for ROA, .437 for ROI, and .372 for profit margin.

Pretests of the measurement scale

In order to increase reliability, decrease measurement error, and improve the validity of the construct measurement the scale items were pretested (Dillman 2000). Three stages of pretesting were employed. The first two stages were focused solely on the refinement of the

FSCA measurement instrument as most of the items measuring this concept were newly developed. The final stage included the FSCA measurement items generated from the first two stages of pretesting, along with the measurement items for the remaining constructs of interest (e.g., ENVU, SCO, MO, customer effectiveness, cost efficiency, and financial performance).

A Q-sort method was employed for the first two stages (Moore and Benbasat 1991; Li et al. 2009). The first one was conducted with a sample of 25 academics and the second with a sample of 100 supply chain managers. Through the Q-sort method, a pool of items was generated to measure the concept of FSCA. Specifically, six items were used to measure *alertness*, seven items to measure *accessibility*, six items to measure *decisiveness*, five items to measure *swiftness*, and six items to measure *flexibility*.

All survey items were included in the final stage. Thirty (30) items were used to measure FSCA, 17 items for MO, 13 items for SCO, 6 items for ENVU, 9 items for customer effectiveness (CUST), 5 items for cost efficiency (COST), and 4 items for financial performance (FINA). The internet-based survey questionnaire was emailed to a sample of 526 mid- and upper-level supply chain and logistics managers of North American companies. The sample was purchased from Dun&Bradstreet, a leading provider of business information. The electronic surveys generated 78 usable responses, which yielded a response rate of 14.8%.

Importantly, the purpose of the final pilot test was to identify poor performing items rather than create highly purified scales (Defee et al., 2009). To be retained in a scale, items had to exceed the recommended 0.70 cutoff for alpha (Churchill, 1979). Exploratory, followed by Confirmatory Factor Analysis, were also conducted to determine whether the item loadings

were clean (no cross-loading between constructs that are supposed to be different from each other) (Mentzer and Flint, 1997). No items were eliminated at this stage.

Data collection and sampling for final model testing

The firm was the unit of analysis for this research, and the preferred target respondents were senior-level managers with knowledge of supply-chain processes and activities, and direct involvement in operational and strategic decision-making. A non-experimental survey methodology was used for data collection (Kerlinger and Lee 2000). We employed a web-based survey approach because the population of interest is businesses, and coverage issues are not present due to high rates of computer use and the large sample size (Dillman 2000).

To achieve a moderate level of external validity and to contribute to the generalizability of results, purposive sampling was employed (Cook and Campbell 1979). Two data sources were used. The first source was a database of supply chain managers maintained by a large public university's supply chain management program. The database contained critical contact information for more than 3,000 managers (name, phone number, e-mail and title) from U.S.-based companies in a diverse set of industries. An email was sent to all contacts in the database requesting participation in the study. The Qualtrics software indicated that the email was received and opened by 285 respondents, confirming that correct/updated contact information existed for these managers. Therefore, this sample of 285 respondents was considered for final survey testing. In order to increase response rate, participants were offered an executive summary of the research findings and entered into a raffle for the chance to win $100.

The second source of potential participants was the panel members of SurveyMonkey, a large third party marketing firm that specializes in survey data collection. SurveyMonkey was

provided the desired sampling criteria and sample size. Based on the desired respondent attributes, 1,135 senior-level managers of diverse backgrounds, with knowledge of supply-chain processes and activities, and direct involvement in operational and strategic decision-making were prequalified to participate in the study. Participants were not provided any direct financial incentives, however SurveyMonkey pledged to donate $.50 to the charity of the respondents' choice, and enter the respondents into a raffle for the chance to win $100.

The main survey test was sent to the sample of 285 potential respondents selected from the university's database of supply chain managers and the sample of 1135 pre-qualified SurveyMonkey panel members. Two reminders spaced one week apart followed the initial email to the sample selected from the university's database. Once all the data collection methods had been concluded, 141 usable responses were received from the university's database for a response rate of 49.5%. A number of 530 usable responses were received from the SurveyMonkey panel members for a response rate of 46.7%. No reminder was sent to the SurveyMonkey panel members because of the initial high response rate. Responses from the two samples were compared using ANOVA and no significant differences were found. Combined, the two samples generated a total of 671 usable responses. The demographics information for the final group of respondents is presented in Table 5.1.

For both groups of respondents, non-response bias was examined using the guidelines suggested by Mentzer and Flint (1997). A random sample of 30 non-respondents was contacted from each group and asked to respond to five non-demographic questions. Specifically, the five questions addressed the construct of FSCA. No statistical difference was

Table 5.1

Demographics for the Final Test Sample

Level of Professional Work Experience	Percentage	Total Company Annual Sales	Percentage	Type of Industry	Percentage
<1 year	4%	<$250 million	18%	Energy/Chemical/Mining	2%
1-3 years	3%	$250 million-$500 million	12%	Communications/Media/ Entertainment	3%
3-5 years	10%	$500 million-$1 billion	10%	Retail	18%
5-10 years	9%	$1-$2 billion	17%	Manufacturing-General	19%
10-15 years	10%	$2-$3 billion	13%	Manufacturing-Consumer products	15%
15-20 years	12%	$3-$5 billion	10%	Manufacturing-Aerospace/defense	4%
20+ years	52%	$5-$9 billion	8%	Manufacturing-High technology	4%
		>$9 billion	12%	Energy/Chemical/Mining	1%
				Financial Services/Insurance	2%
				Life Sciences-Pharmaceuticals	3%
				Life Sciences-Medical devices	3%
				Health Managed Care	2%
				Transportation Service Provider	8%
				Other	16%
Total	100%		100%		100%

found between the answers to these questions of respondents and non-respondents. Therefore, non-response bias is not considered a problem with the data.

Scale purification

The primary approaches for measurement item purification included multiple iterations of confirmatory factor analysis (CFA), with the maximum likelihood estimation (MLE) method that iteratively improves parameter estimates to minimize a specified fit function. In addition to the statistical analyses, theoretical assessment was made prior to final deletion of any

measurement items. When modifying the model, indicators such as offending estimates, squared multiple correlations, standardized residual covariances, and modification indices were evaluated. Next, each scale was examined for unidimensionality, reliability, convergent and discriminant validity. Analysis results provided inadequate evidence of discriminant validity among the five FSCA dimensions and the three MO dimensions, respectively. Therefore, both FSCA and MO were measured as first order constructs. This is consistent with past research that operationalized FSCA and MO as first order constructs (i.e., Gligor and Holcomb 2012b; Qu and Ennew 2008). Further consideration of convergent validity criteria resulted in 55 acceptable items. These items, along with their sources, are presented in Appendix 5.A. Descriptive statistics and correlation matrix for all constructs are presented in Table 5.2.

Table 5.2

Correlation Matrix and Descriptive Statistics for Constructs

	Mean	SD	**FSCA**	**ENVU**	**SCO**	**MO**	**CUST**	**COST**	**FINA**
FSCA	2.984	.943	1						
ENVU	3.000	1.048	.550*	1					
SCO	2.757	.947	.848*	.577*	1				
MO	3.137	1.00	.813*	.647*	.809*	1			
CUST	3.200	1.052	.572*	.365*	.563*	.506*	1		
COST	3.832	.927	.260*	.064	.251*	.171*	.299*	1	
FINA	3.400	1.127	.439*	.311*	.424*	.438*	.482*	.331*	1

*Correlation significant at the 0.01 level

Analysis of scale measurement reliability and construct validity

Reliability was assessed using Cronbach's Coefficient Alpha, with a rule that an alpha above .70 indicates good correlation between the item and the true scores (Churchill 1979). Because coefficient alpha tends to underestimate scale reliability and has several limitations,

Table 5.3

Reliability Results and Item Statistics

Scale/Item	Cronbach Alpha for Scale	Alpha if Item Deleted	CR	Item-to-Total Correlation	Mean	SD	Item Loadings	Average Variance Extracted
FSCA	0.941		0.941					0.533
FSCA1		0.936		0.744	2.97	1.169	0.79	
FSCA2		0.936		0.753	3.13	1.262	0.776	
FSCA3		0.936		0.766	3.04	1.233	0.773	
FSCA4		0.94		0.61	3.15	1.346	0.618	
FSCA5		0.94		0.613	3.19	1.358	0.622	
FSCA6		0.936		0.739	0.287	1.168	0.722	
FSCA7		0.937		0.734	2.96	1.208	0.722	
FSCA8		0.936		0.77	2.94	1.191	0.797	
FSCA9		0.936		0.75	3.08	1.226	0.622	
FSCA10		0.936		0.76	3.03	1.331	0.73	
FSCA11		0.936		0.75	2.95	1.244	0.658	
FSCA12		0.94		0.611	2.93	1.273	0.778	
FSCA13		0.937		0.717	2.85	1.21	0.78	
FSCA14		0.939		0.634	2.71	1.299	0.788	
ENVU	0.727		0.731					0.406
ENVU1		0.616		0.599	2.9	1.457	0.718	
ENVU2		0.673		0.506	3.23	1.464	0.634	
ENVU3		0.692		0.472	3.29	1.359	0.586	
ENVU4		0.68		0.493	2.68	1.371	0.604	
SCO	0.93		0.931					0.550
SCO1		0.924		0.718	2.65	1.266	0.739	
SCO2		0.925		0.682	2.76	1.168	0.708	
SCO3		0.923		0.728	2.75	1.225	0.767	
SCO4		0.924		0.71	2.93	1.317	0.757	
SCO5		0.922		0.761	2.96	1.266	0.798	
SCO6		0.923		0.741	2.66	1.268	0.759	
SCO7		0.922		0.749	2.61	1.219	0.77	
SCO8		0.927		0.649	2.91	1.151	0.692	
SCO9		0.922		0.764	2.82	1.243	0.788	
SCO10		0.927		0.633	2.37	1.174	0.727	
SCO11		0.925		0.697	2.92	1.266	0.638	

Table 5.3 Continued

Scale/Item	Cronbach Alpha for Scale	Alpha if Item Deleted	CR	Item-to-Total Correlation	Mean	SD	Item Loadings	Average Variance Extracted
MO	0.9		0.900					0.476
MO1		0.888		0.671	3.37	1.405	0.665	
MO2		0.892		0.613	3.14	1.327	0.702	
MO3		0.891		0.626	3.14	1.392	0.662	
MO4		0.895		0.562	2.99	1.384	0.615	
MO5		0.888		0.681	3.3	1.506	0.7	
MO5		0.886		0.699	3.09	1.377	0.735	
MO7		0.889		0.662	2.93	1.277	0.718	
MOO8		0.888		0.675	3.16	1.401	0.712	
MO9		0.888		0.685	3.06	1.32	0.735	
MO10		0.892		0.626	3.21	1.523	0.643	
CUST	0.926		0.927					0.616
CUST1		0.919		0.72	3	1.28	0.74	
CUST2		0.922		0.678	3.24	1.27	0.697	
CUST3		0.921		0.693	3.16	1.328	0.719	
CUST4		0.92		0.698	3.3	1.304	0.731	
CUST5		0.911		0.812	3.15	1.28	0.848	
CUST6		0.912		0.813	3.29	1.269	0.86	
CUST7		0.912		0.811	3.31	1.275	0.806	
CUST8		0.915		0.766	3.16	1.362	0.855	
COST	0.797		0.799					0.500
COST1		0.727		0.647	3.84	1.203	0.766	
COST2		0.758		0.586	3.87	1.174	0.661	
COST3		0.77		0.56	3.74	1.175	0.634	
COST4		0.73		0.644	3.78	1.15	0.759	
FINA	0.905		0.908					0.712
FINA1		0.884		0.767	3.39	1.282	0.824	
FINA2		0.863		0.83	3.4	1.215	0.894	
FINA3		0.862		0.829	3.39	1.227	0.884	
FINA4		0.9		0.728	3.41	1.334	0.768	

Garver and Mentzer (1999) suggest that construct reliability should also exceed .70 to indicate adequate reliability. Results in Table 5.3 indicate good internal consistency.

Construct validity was examined through the adequacy of the model's fit and both convergent validity and discriminant validity. A model is considered to be satisfactory if the comparative fit index (CFI) is greater than 0.90, and the root mean square error of approximation (RMSEA) is less than 0.08 (Byrne 1998). AMOS 20 was used to implement a CFA. Results indicate good fit for the measurement model with a *Chi-square* of 3632.138 and 1409 degrees of freedom, CFI=0.904, and RMSEA=0.049. Further, the adjusted goodness-of-fit (AGFI) of .801, exceeds the 0.8 cut-off implying good absolute model fit (Browne and Cudeck 2003).

Convergent validity was examined using the Bentler-Bonett coefficient (Bentler and Bonnet, 1980). The coefficient represents the ratio of the difference between the chi-squared value of the null measurement model and the specified measurement model to the chi-square value of the null model. In confirmatory factor analysis, the null model has no hypothesized factor loading on a common construct. According to Bentler and Bonnet (1990), a coefficient value between 0.80 and 0.90 is acceptable. The Bentler-Bonnet coefficient for our model is 0.853, which indicates adequate convergent validity. Also, for satisfactory convergent validity, the estimated parameters between the latent variables and their indicators should be at least 0.50, and preferably .70 (Hair et al. 1998). Results in Table 5.3 indicate that all constructs passed this test. Therefore, convergent validity is supported.

Discriminant validity was assessed by running a series of nested CFA model comparisons in which the covariance between each pair of constructs (one pair at a time) was constrained to one (Anderson and Gerbing 1988; Bagozzi and Yi 1988). If the chi-square difference test is significant when all of the correlations between the constructs are fixed to one for the theoretical model, and for the measurement model allowing the two constructs to correlate

freely, then the constructs are deemed to discriminate adequately (Joreskog and Sorbom 1989; Venkatraman 1989). Table 5.4 indicates that all constructs passed this test. In aggregate, the results suggest adequate discriminant validity.

Table 5.4
Chi-square Difference Test to Assess Discriminant Validity

	ENVU	SCO	MO	CUST	COST	FINA
FSCA (X^2_{diff})	323.978	350.091	437.915	2074.12	744.676	5080.512
ENVU(X^2_{diff})		250.835	132.153	618.141	825.911	665.159
SCO(X^2_{diff})			282.768	1994.03	754.526	1444.78
MO(X^2_{diff})				1973.15	790.945	1410.32
CUST(X^2_{diff})					696.572	1328.19
COST(X^2_{diff})						4288.364

Notes: $p<0.001$; $df_{diff}=6$

Common method variance

Procedural methods were applied to minimize the potential for common method bias since both the independent and dependent measures were obtained from the same source. We ensured our sample included mid- to senior-level managers that had significant levels of relevant knowledge, which tends to mitigate single source bias (Mitchell 1985). Common method bias was also reduced by separating the predictor and criterion variable items over the length of the survey instrument and by assuring participants that their responses would be kept anonymous (Podsakoff et al. 2003). Previous research was consulted and an iterative process of reviewing, pilot testing, and revising the survey with a group of academic experts, was conducted in an effort to minimize the potential for context effects (Lindell and Whitney 2001). Finally, Harman's one-factor test was performed to refute the issue of common method bias (Harman 1976; Podsakoff and Organ 1986). A factor analysis performed on the variables did not yield a single-factor solution. Therefore, the threat of common method bias is not

significant. In summary, based on tests of reliability, validity, and overall model fit, there is strong support for the suitability of the constructs employed in this research.

Analysis and Results

Structural equation modeling (SEM) was employed to estimate the proposed research model. Results indicate a good fit for the measurement model with a *Chi-square* of 3721.505 and 1421 degrees of freedom, CFI=0.901, and RMSEA=0.050 (Browne and Cudeck, 1993).

The standardized coefficient weights and critical ratios (CR) for each causal path are provided in Table 5.5. Analysis results provide support for H1 ($p<0.01$). There is a direct and positive relationship between a firm's degree of ENVU and its level of MO. Hypothesis 2 was not supported, which indicates that a firm's degree of ENVU does not directly impact its level of SCO. Since H3 was significant, and there is a direct causal relationship between MO and SCO, it could be that MO fully mediates the relationship between ENVU and SCO. To explore this possibility, the mediation tests recommended by James and Brett (1984) were conducted. To assess the mediation role of MO in the relationship between ENVU and SCO we first compared the model in Fig. 1 with the same model without the path from ENVU to SCO (a fully mediated model). These models were not significantly different $\chi^2[1] =0.138$ and displayed identical fit. Thus, support exists that the effect of ENVU on SCO is fully mediated by MO since the addition of the path from ENVU to SCO does not add significantly to the model and the fully mediated model is more parsimonious.

The steps suggested by Baron and Kenny (1986) were also followed to test for mediation: Step 1: Use SCO as the dependent variable and ENVU as the independent variable, test the statistical significance of the relationship; Step 2: Use MO as the dependent variable

and ENVU as the independent variable, test the statistical significance of the relationship; Step 3: Use SCO as the dependent variable and MO as the independent variable, test the statistical significance of the relationship; Step 4: Test the effect of ENVU on SCO when controlling for MO. For MO to completely mediate the relationship between ENVU and SCO, the relationship between ENVU and SCO should be statistically non-significant. The relationships described in the first three steps were significant, while the relationship described in the fourth step was not. Combined, the results suggest MO is a full mediator: the level of ENVU directly impacts the firm's level of MO, which in turn directly impacts its level of SCO.

As Table 5.5 indicates, hypotheses 4-9 were fully supported. Both SCO and MO contribute directly to the development of FSCA. Also, FSCA leads to better FINA through a direct positive impact on CUST and COST. The implications associated with these results are explained in the following section.

Table 5.5
Hypotheses Testing Results

Hypothesis No.	Path	Expected relationship	Std. Weights	Critical Ratios	Supported?
H1:	MO ⬅ ENVU	+	.781	12.161	Yes; p<.001
H2:	SCO ⬅ ENVU	+	- .021	- .372	No; p=.710
H3:	SCO ⬅ MO	+	.906	11.762	Yes; p<.001
H4:	FSCA ⬅ SCO	+	.625	9.826	Yes; p<.001
H5:	FSCA ⬅ MO	+	.316	5.260	Yes; p<.001
H6:	CUST ⬅ FSCA	+	.610	13.791	Yes; p<.001
H7:	COST ⬅ FSCA	+	.304	6.737	Yes; p<.001
H8:	FINA ⬅ CUST	+	.449	10.583	Yes; p<.001
H9:	FINA ⬅ COST	+	.248	5.935	Yes; p<.001

IMPLICATIONS, LIMITATIONS, AND FUTURE RESEARCH

Our research contributes to a better understanding of strategic-level antecedents of FSCA. This research is the first to empirically examine the level of ENVU that is more conducive to the development of FSCA. The results empirically confirm FSCA to be a competitive vehicle for firms operating in uncertain business environments (Tseng and Lin 2011). While the findings highlight to managers the importance of developing FSCA, they also suggest that a balanced approach is recommended: the level of FSCA should be strategically designed based on the firm's level of ENVU. For instance, devoting resources to the creation of a FSCA level beyond the firm's environmental requirements could result in suboptimal organizational performance.

This research also contributes to agility theory development within the supply chain domain by expanding on the work of Braunscheidel and Suresh (2009) who explored the role of different managerial orientations in achieving firm supply chain agility. We establish a direct link between MO, SCO, and FSCA. This study also empirically confirms Min, Mentzer and Ladd's (2007) contention that firms must become market oriented before they can recognize the value of managing the supply chain (i.e., SCO). To managers, it indicates that firms that are not market oriented are not likely to possess the knowledge needed to design the optimal level of FSCA. Also, in order to achieve the desired FSCA level firms must have both, a MO and a SCO. These findings help guide managers on how to best distribute limited resources to enhance FSCA. For example, especially in market-driven organizations, allocating resources for demand-management initiatives at the expense of supply-management initiatives can negatively impact the firm's ability to respond to its customers' needs because of a suboptimal level of FSCA.

Although the difference between SCO's strategic and structural aspects has been established (Esper et al. 2010), researchers have focused exclusively on the latter when developing measures for the concept (i.e., Min et al. 2007). Successful creation of SCO entails placing strategic focus on SCM (SCO strategy) and supporting this strategic focus through SCO structure (Esper et al. 2010). This implies that a rigorous SCO measurement instrument would also capture the concepts' strategic elements. Therefore, a key theoretical contribution of the current research is the development of a measurement scale that captures both SCO's strategic and structural elements. For managers, the measurement scale items provide guidelines on the strategic- and structural-related initiatives that can facilitate the development of SCO.

Our findings further expand theory by providing a more detailed explanation regarding the impact of FSCA on firm performance. FSCA was found to contribute directly and positively to both organizational efficiency and effectiveness. Agility has been traditionally linked to CUST and considered the opposite of lean, which has been linked to COST (Goldsby et al. 2006). Therefore, a key contribution of this research is the establishment of a direct link between FSCA and efficiency. For managers, it implies that FSCA contributes not only to meeting the customers' ever-changing expectations, but also to meeting those expectations in a cost-efficient manner.

Finally, our research advances theory by using secondary data to investigate the impact of FSCA on the organization's FINA. When strategically developed, FSCA was found to positively impact the organization's financial results. The use of secondary data provides credible evidence to managers regarding the positive impact of FSCA on FINA.

The findings must be interpreted against the backdrop of methodological limitations of our research, which presents additional future research opportunities. The cross-sectional research design limits the extent to which cause-effect relationships can be inferred. This limitation can be addressed in future research through the collection of longitudinal data. All data was collected from only one member of a specific supply chain. The use of dyadic or triadic data would help truly capture the essence of a supply chain. Further, the impact on performance can be examined through the use of mathematical modeling. For example, simulation research enables the examination and measurement of the variation of variables in the model and can offer additional insight into the relationship between FSCA and other variables of interest.

This research uses the firm as the unit of analysis. As Gligor and Autry (2012) indicate, ultimately it is individuals that make decisions within supply chains. Therefore, there is a need for micro-level studies that analyze FSCA considering the manager as the focus of analysis. Future research is also needed to expand on the FSCA theoretical models that scholars have introduced thus far. Additional FSCA antecedents and performance outcomes remain to be identified. This study provides a building block in that process.

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APPENDICES

Appendix 4.A

Firm Supply Chain Agility Survey Items and Sources

	Firm Supply Chain Agility: Alertness
A1	Our firm can promptly identify **opportunities** in its environment. (Adapted from Li et al. 2009)
A2	My organization can rapidly sense **threats** in its environment. (Adapted from Li et al. 2009)
A3	We can quickly detect **changes** in our environment. (Adapted from Li et al. 2009)
	Firm Supply Chain Agility: Accessibility
B1	We always receive the information we demand from our **suppliers**. (Newly Developed)
B2	We always obtain the information we request from our **customers**. (Newly Developed)
	Firm Supply Chain Agility: Decisiveness
C1	We can make definite decisions to address **opportunities** in our environment. (Newly Developed)
C2	My organization can make firm decisions to respond to **threats** in its environment. (Newly Developed)
C3	My company can make resolute decisions to deal with **changes** in its environment. (Newly Developed)
	Firm Supply Chain Agility: Swiftness
D1	We can swiftly deal with **threats** in our environment. (Newly Developed)
D2	My firm can quickly respond to **changes** in the business environment. (Newly Developed)
D3	We can rapidly address **opportunities** in our environment. (Newly Developed).
	Firm Supply Chain Agility: Flexibility
E1	When needed, we can adjust our supply chain operations to the extent necessary to execute our decisions. (Newly Developed)
E2	My firm can increase its short-term capacity as needed. (Adapted from Tachizawa and Gimenez 2010)
E3	We can adjust the specification of orders as requested by our customers. (Adapted from Tachizawa and Gimenez 2010)

Appendix 5.A

Survey Items and Sources

Supply Chain Orientation *Range: strongly agree—strongly disagree (7 point Likert scale)*	*Source/ Adapted From:*
Our objectives are consistent with those of our suppliers.	Min et al. 2007
Our organization places a high priority on maintaining relationships with our key supply chain members.	Min et al. 2007
We trust our key supply chain members.	Min et al. 2007
We believe our supply chain members must work together to be successful.	Min et al. 2007
Our top managers reinforce the need for sharing valuable information with our supply chain members.	Min et al. 2007
We view our supply chain as a value added piece of our business.	Min et al. 2007
Our organization recognizes the strategic importance of managing its supply chain.	Newly Developed
Our organization recognizes the strategic importance of coordinating business functions *within our firm*.	Newly Developed
Our organization recognizes the strategic importance of coordinating business functions *across firms* within the supply chain.	Newly Developed
Our organization recognizes the strategic importance of integrating *inter-firm processes.*	Newly Developed
Our organization recognizes the strategic importance of integrating *intra-firm processes.*	Newly Developed
Market Orientation *Range: strongly agree—strongly disagree (7 point Likert scale)*	
Intelligence generation (MO 1st dimension) We periodically review the likely effect of changes in our business environment (e.g., regulation) on customers.	Min et al. 2007
In this business unit, we frequently collect and evaluate general macro economic information (e.g., interest rate, exchange rate, GDP, industry growth rate, inflation rate).	Min et al. 2007
In this business unit, we collect and evaluate information concerning general social trends (e.g., environmental consciousness, emerging lifestyles) that might affect our business.	Min et al. 2007
In this business unit, we spend time with our suppliers to learn more about various aspects of their business (e.g., manufacturing process, industry	Min et al. 2007

practices, clientele).	
Intelligence dissemination (MO 2ND dimension) We have cross-functional meetings very often to discuss market trends and developments (e.g., customers, competition, suppliers).	Min et al. 2007
Technical people in this business unit spend a lot of time-sharing information about technology for new products with other departments.	Min et al. 2007
Market information spreads quickly through all levels in this business unit.	Min et al. 2007
Response to intelligence (MO 3rd dimension) For one reason or another, we tend to ignore changes in our customers' product or service needs. (R)	Min et al. 2007
The product lines we sell depend more on internal politics than real market needs. (R)	Min et al. 2007
We tend to take longer than our competitors to respond to a change in regulatory policy. (R)	Min et al. 2007
Customer Effectiveness *For the following items, please indicate the degree to which your business unit's goals were met over the last year:* *Range: Exceeded our goals---Met our goals—Fell below our goals (7 point scale)*	
Ability to handle customer emergencies.	Fugate et al. 2009
Ability to handle nonstandard orders to meet special needs.	Fugate et al. 2009
Ability to provide customers real-time information about their orders.	Fugate et al. 2009
Stock availability.	Fugate et al. 2009
Order fulfillment.	Fugate et al. 2009
Order-to-delivery cycle time.	Fugate et al. 2009
Order-to-delivery cycle time consistency.	Fugate et al. 2009
On-time deliveries.	Fugate et al. 2009
Cost Efficiency *For the following items, please rate your business unit's performance over the last year relative to your main competitors:* Range: Far Below Competitors---On Par With---Far Above Competitors (7 point scale)	
Distribution costs (including transportation and handling costs).	Fugate et al. 2009

Manufacturing costs (including labor, maintenance, and re-work costs).	Fugate et al. 2009
Inventory costs (including inventory investment and obsolescence, work-in-progress, and finished goods).	Fugate et al. 2009
Supply chain costs as a percent of revenue.	Fugate et al. 2009
Financial Performance In your judgment, how did your business unit perform relative to its major competitors in the previous fiscal year with respect to each criterion? If you are associated with a company that does not consist of business units or divisions, please answer the following based on your company: *Range: far below competitors-on par-far above competitors*	
Return on sales (ROS).	Fugate et al. 2009
Return on assets (ROA).	Fugate et al. 2009
Return on investment (ROI).	Fugate et al. 2009
Profit margin.	Fugate et al. 2009
Environmental Uncertainty *Range: strongly agree—strongly disagree (7 point Likert scale)*	
As compared to other industries, our industry has a higher capacity for growth.	Liang et al. 2010
Our industry is more complex to operate in as compared to other industries.	Liang et al. 2010
Competition is ever changing in our market.	Wang et al. 2011
The technology in our industry is changing rapidly.	Chen and Paulraj 2004
Firm Supply Chain Agility *Range: strongly agree—strongly disagree (7 point Likert scale)*	
Alertness (FSCA 1ST dimension) We can quickly detect **changes** in our environment.	Li et al. 2009
Our firm can promptly identify **opportunities** in its environment.	Li et al. 2009
My organization can rapidly sense **threats** in its environment.	Li et al. 2009
Accessibility(FSCA 2nd dimension)	

We always receive the information we demand from our **suppliers**.	Newly Developed
We always obtain the information we request from our **customers**.	Newly Developed
Decisiveness (FSCA 3rd dimension)	
My company can make resolute decisions to deal with **changes** in its environment.	Newly Developed
We can make definite decisions to address **opportunities** in our environment.	Newly Developed
My organization can make firm decisions to respond to **threats** in its environment.	Newly Developed
Swiftness (FSCA 4th dimension)	
My firm can quickly respond to **changes** in the business environment.	Newly Developed
We can rapidly address **opportunities** in our environment.	Newly Developed
We can swiftly deal with **threats** in our environment.	Newly Developed
Flexibility (FSCA 5thdimension)	
When needed, we can adjust our supply chain operations to the extent necessary to execute our decisions.	Newly Developed
My firm can increase its short-term capacity as needed.	Tachizawa and Gimenez 2010
We can adjust the specification of orders as requested by our customers.	Tachizawa and Gimenez 2010

VITA

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