

# Understanding the role of logistics capabilities in achieving supply chain agility: a systematic literature review

David M. Gligor and Mary C. Holcomb

Department of Marketing and Logistics, University of Tennessee, Knoxville, Tennessee, USA

## Abstract

**Purpose** – The purpose of this paper is to explore the role of logistics capabilities in achieving supply chain agility through a multi-disciplinary review of the relevant research. The systematic literature review aims to provide the basis for formulating a conceptual framework of the relationship.

**Design/methodology/approach** – A systematic, comprehensive review of the literature on manufacturing, organizational and supply chain agility from 1991 through 2010 was conducted. The literature on logistics capabilities was also examined to identify the various elements that contribute to supply chain agility.

**Findings** – Supply chain agility has primarily been explored in the literature through a focus on manufacturing flexibility, supply chain speed, or lean manufacturing. The role of logistics capabilities in achieving supply chain agility has not been addressed from a holistic conceptual perspective. This research addresses that gap using a multi-disciplinary approach. As such, it is the first phase in theory building on the concept of supply chain agility. Further research is needed to empirically test the conceptualized relationships.

**Research limitations/implications** – This research is a systematic, integrative review of the existing literature on the concept of agility and logistics capabilities. As such, the next phase of research needed for theory building will be the operationalization of constructs and testing of the hypothesized relationships proposed by the conceptual framework.

**Practical implications** – The level of agility in a supply chain can determine the efficiency and effectiveness of the collective efforts. It is important that firms become more knowledgeable about the role of logistics capabilities in achieving agility.

**Originality/value** – Through a systematic, comprehensive review of the literature in four distinct areas, the paper explores the relationship between logistics capabilities and supply chain agility.

**Keywords** Agility, Logistics capabilities, Supply chain orientation, Supply chain agility, Supply chain management, Distribution management

**Paper type** Literature review

## Introduction

Agility is considered to be one of the fundamental characteristics needed for a supply chain to survive and thrive in an environment of turbulent and volatile markets (Agarwal *et al.*, 2007; Braunscheidel and Suresh, 2009). As these conditions become the norm due to reduced product life cycles, increased demand for customized products and services, reduced visibility of demand, and constant change (Brown and Eisenhardt, 1998; Kumar and Deshmukh, 2006; Swafford *et al.*, 2008), organizations have acknowledged that agility is essential for their endurance and competitiveness more than ever before (Lin *et al.*, 2006). Agility has been noted as an organizational enabler of quick and effective reaction that enables the firm to establish a competitive advantage (Goldman *et al.*, 1995; Swafford *et al.*, 2006). Moreover, a firm's supply chain agility has been identified as a critical factor affecting its overall global competitiveness (Lee, 2004).

It has been shown that firms with supply chain agility can respond better to unforeseen changes as they are able to better synchronize supply with demand (Swafford *et al.*, 2008). Synchronization of supply and demand requires integration across a firm's internal functions as well as its suppliers and customers (Narasimhan, 1997) as firms no longer compete against each other as independent entities. Today's competition is supply chain against supply chain (Christopher, 2000; Lambert and Cooper, 2000; Christopher and Towill, 2001). Research indicates that the key to achieving competitive advantage in the current business environment is for firms to be aligned with suppliers, the suppliers of the suppliers, customers and the customers of the customers, and even with competitors in order to streamline operations (van Hoek, 2001). This is also a basic principle for creating agility; members of the supply chain must be capable of rapidly aligning their collective capabilities to respond to changes in market and customer demand.

Supply chain agility has primarily been explored in the literature by focusing on manufacturing flexibility, supply chain speed, or lean manufacturing (Gunasekaran and Yusuf,

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2002; Hofman and Cecere, 2005; Swafford *et al.*, 2006). While specific logistics elements such as speed and responsiveness have been examined by previous studies (Li *et al.*, 2008; Sharifi and Zhang, 1999; Kidd, 1994), the broader role of logistics capabilities in achieving supply chain agility has not been addressed from a holistic conceptual perspective. This prompts the following research question: “What is the relationship between logistics capabilities and supply chain agility?” Considering logistics’ boundary-spanning nature, it is the premise of this paper that firm-specific logistics capabilities, developed as a result of the firm’s supply chain orientation, result in emergent supply chain logistics capabilities that lead to supply chain agility.

Gaining a better understanding of the relationship between logistics capabilities and supply chain agility has managerial as well as theoretical implications. The role of agility in the supply chain is to enable the respective members to respond quickly to unanticipated changes in supply and/or demand (Lee, 2004). Logistics capabilities have been shown to be valuable factors in enabling firms to respond to changing business conditions in an efficient and effective manner. Multiple processes and sub-processes are involved in the fulfillment of demand from supply to distribution of products to the customer. Therefore, managers need to be aware of how capabilities, and specifically logistics capabilities, can be used to react and respond to market turbulence.

### Using an integrative literature review to examine supply chain agility

In order to explore the role of logistics capabilities in achieving supply chain agility, a multi-disciplinary integrative literature review is used to develop a holistic perspective. An integrative literature review is a process that contains five stages including:

- 1 problem formulation;
- 2 literature search;
- 3 evaluation of research;
- 4 research analysis and interpretation; and
- 5 presentation of results (Cooper, 1982; Whittemore and Knafl, 2005).

The primary purpose of the integrative research review is to summarize the accumulated body of knowledge concerning the relations of interest and to determine where gaps exist. In this paper the relations of interest are agility and logistics capabilities. While both of these areas have extensive research bases, little is known about the role of logistics capabilities in enabling the firm to achieve agility. In order to advance the understanding and knowledge of the relationship of these two phenomena, an integrative review of the respective literature is needed to define the concepts (Broome, 1993). Moreover, the integrative review of the concepts is needed as the basis for advancing theory on supply chain agility. Torraco (2005) asserts that when a topic is relatively new a comprehensive review is more likely to lead to an initial or preliminary conceptualization of the topic rather than a reconceptualization of previous models. Such is the case with supply chain agility.

Four distinct literature areas are examined in this paper. First, the manufacturing literature related to the concept of agility is reviewed to help establish the characteristics and elements of the concept itself. Second, the literature relevant

to organizational agility is looked at to establish the characteristics of an agile organization. Third, a review of the literature on supply chain agility is conducted to help establish the characteristics and elements of the concept of supply chain agility. Fourth, the literature on logistics capabilities is examined to identify the various elements that contribute to supply chain agility. The various literature reviews are evaluated and interpreted to develop a conceptual model linking logistics capabilities and supply chain agility. In the last section of the paper conclusions and theoretical and managerial implications are presented.

### Research methodology

The guidelines on conducting a systematic review of a literature base were followed in order to ensure that an unbiased and valid evaluation was conducted (Tranfield *et al.*, 2003; Rousseau *et al.*, 2008; Denyer and Tranfield, 2009). Systematic reviews employ a series of techniques for minimizing bias and error through exhaustive literature searches of published and unpublished studies while providing an audit trail of the reviewers’ decisions, procedures and conclusions (Cook *et al.* 1997). A comprehensive review of the existing bodies of literature on manufacturing agility, supply chain agility and logistics capabilities was conducted beginning with a search of the EBSCO database. A generalized graphical illustration of this process is presented in the Appendix (Figure A1).

Key search terms (and variations thereof) for each of the areas of interest were used to examine peer reviewed journal articles published from 1991 through 2010. For example, keywords used for manufacturing agility included “manufacturing”, “firm”, “organization”, “agility”, and “agile”. Given that not all journals and papers are accessible through periodical databases, the researchers also traced citations in identified papers to find additional works. This process was conducted until the authors reached a saturation point wherein no additional articles were found. These steps were taken to facilitate auditability and repeatability (for a list of stages in conducting a systematic review please see Clarke and Oxman, 2001).

A total of 175 papers were collected and assessed following the above process for manufacturing agility. Each paper was reviewed to identify the various definitions used for agility, the characteristics of the concept as well as its enablers. For each area of interest to this research, the number of paper citations was the primary criterion considered in evaluating each manuscript’s contribution. For supply chain agility, 67 papers were collected and assessed. Additionally, each paper was reviewed in order to eliminate those articles not related to supply chain agility. As a result 57 papers were found to specifically address the topic of supply chain agility. For logistics capabilities, 47 papers were collected and assessed following the above process. After reviewing each manuscript, 31 papers were found to specifically address the topic of logistics capabilities.

### Agility from a manufacturing perspective

#### Defining agility

The concept of agility originated in manufacturing and was popularized in 1991 by a group of scholars at the Iaccoca Institute of Lehigh University (Goldman and Preiss, 1991).

Agility quickly became a focal reference for manufacturing systems studies (Nagel and Dove, 1991). The concept 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 defined agility as:

A manufacturing system with extraordinary capabilities (Internal capabilities: hard and soft technologies, human resources, educated management, information) to meet the rapidly changing needs of the marketplace (speed, flexibility, customers, competitors, suppliers, infrastructure, responsiveness). A system that shifts quickly (speed, and responsiveness) among product models or between product lines (flexibility), ideally in real-time response to customer demand (customer needs and wants) (Yusuf *et al.*, 1999, p. 36).

As is often the case with a new concept, some scholars believed that agility as expounded by the Iacocca Institute was ill-defined (Burgess, 1994) and that it lacked grounding in a theoretical perspective (Yusuf *et al.*, 1999). Consequently, after the publication of the Iacocca Institute report, a variety of subsequent journal articles dealing with the topic of agile manufacturing attempted to define and explain the concept. Some of the more notable definitions 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 conceptualized agility as a construct with the following strategic dimensions: enriching the customer, cooperating both internally and externally to enhance the competitiveness, organizing to both adapt and thrive on change and uncertainty, and leveraging the impact of people and information. Their research has served as the starting point for a large number of authors who have proposed different characteristics and properties of agility. As an example, Gunasekaran (1998) viewed 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 used the elements of uncertain and changing demand in their definition of agility. They deemed production to be agile if it could efficiently change operating states in response to a changeable environment.

Other researchers provide a similar interpretation of agility such as Sarkis (2001) who defined agility as the ability to thrive in an environment of continuous and often unanticipated change. DeVor *et al.* (1997) viewed 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) characterized agility as the ability to cope with unexpected changes, to survive unprecedented threats of business environment, and to take advantage of changes as opportunities. The authors added a new dimension to the concept, which was the ability to capitalize on change as an opportunity.

Dove (1994, 1999) offered a more comprehensive definition of agility, that was also adopted by Yusuf *et al.* (1999), conceptualizing agility 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 state of agility. Yusuf *et al.* (1999) adopted Dove's definition of agility and contributed to the research base by identifying some of the prerequisites to becoming agile. More recent definitions conceptualize agility as a paradigm that facilitates companies to quickly respond to customers' dynamic demands (Brown and Bessant, 2003; Vinodh, 2010).

### Analysis and interpretation

Interestingly, a chronological study of the manufacturing literature shows that the initial focus on agility 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 for companies to achieve agility seems to be driven by a need to deliver value to the customer 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 I provides a synthesis of the research from the systematic review of the different definitions offered for agility. 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 the definition of agility. Although the early definitions of agility had little commonality, there appears to be more convergence between the present definitions.

### Agile manufacturing enablers

While the above literature review identified the characteristics of agility as well as some of the prerequisites to achieving agility, identification of agility enablers is also needed in order to build the foundation required to explore how logistics capabilities contribute to supply chain agility. To this end, each article identified in the previous review of agility literature was further analyzed. A number of enablers of agility have been identified in the agile manufacturing literature (Sharp *et al.* 1999; Gunasekaran, 1999; Yusuf *et al.* 1999; Sharifi and Zhang, 2000, 2001; Bamber *et al.*, 2000). A good starting point is the work of Gehani (1995) who suggests that certain actions are needed in order to implement an agility-based strategy such as cross functional teams, integration of technology, the ability to delay design specification, and enterprise assimilation of learning. Technological capabilities, and specifically information technology, appears prominently throughout the literature as an enabler of agility (Sharp *et al.*, 1999; Sharifi and Zhang, 2000; 2001; Frayret *et al.*, 2001; Coronado *et al.*, 2002).

Table I Selected definitions of agility from a manufacturing perspective

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	The synthesized use of developed and well known technologies and methods of manufacturing that are mutually compatible, involving employee empowerment and OPT
Booth, 1995	A vision of manufacturing that is a natural development from the original concept of "lean manufacturing" with an emphasis on cost cutting and the need to become more flexible and responsive to customers
Goldman <i>et al.</i> , 1995	A construct with strategic dimensions including: enriching the customer, cooperating to enhance competitiveness, organizing to adapt and thrive on change and uncertainty, and leveraging the impact of people and information
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
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
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
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
Sanchez and Nahi, 2001	Characterized by: cooperativeness and synergism; a strategic vision that enables thriving in face of continuous and unpredictable change, the responsive creation and delivery of customer-valued, high quality and mass customized goods/services
Gunasekaran and Yusuf, 2002	The capability of an organization, by proactively establishing virtual manufacturing with an efficient product development system, to: meet the changing market requirements; maximize customer service level; and minimize the cost of goods
Narasimhan <i>et al.</i> , 2006	The ability to efficiently change operating states in response to uncertain and changing market conditions
Swofford <i>et al.</i> , 2006	Ability to adapt or respond in a speedy manner to changing market conditions
Braunscheidel and Suresh, 2009	Capability of the firm, both internally and in conjunction with its key suppliers, to adapt or respond in a speedy manner to changes as well as potential or actual disruptions

In one of the most cited articles on agile manufacturing enablers, Gunasekaran (1998) identifies seven key enablers of agile manufacturing:

- 1 virtual enterprise formation;
- 2 physically distributed manufacturing architecture and teams;
- 3 rapid partnership formation tools/metrics;
- 4 concurrent engineering;
- 5 integrated product/production/business information system;
- 6 rapid prototyping tool; and
- 7 electronic commerce.

Later, based on an extensive literature review, Gunasekaran (1999) proposed a research framework for the design of agile manufacturing systems based on four broad dimensions:

- 1 strategies;
- 2 technology;
- 3 people; and
- 4 systems.

His research suggests that the formation of a virtual enterprise formation is one of the key strategies needed to achieve agility in manufacturing.



Yusuf *et al.* (1999) also confirmed the virtual enterprise as a key enabler of agile manufacturing along with the capability for reconfiguration and a knowledge-driven enterprise. Virtual enterprise (VE) is one of the enablers credited most frequently with helping customers in rapidly obtaining the products that they want (Cho *et al.*, 1996; Sharp *et al.*, 1999).

Sharp *et al.* (1999) explored the key enablers required for agile manufacturing through their study of leading UK organizations. The findings revealed a wide range of enablers, some of which that have been confirmed in other studies and several new ones such as a focus on core competencies and change management and risk. In their proposed framework Sharifi and Zhang (2001) identify four major categories of agility enablers that aligned similarly with the research by Gunasekaran (1999). The research by Sharifi and Zhang (2001) makes an important contribution through their categorization of agility capabilities as responsiveness, competency, flexibility, and speed.

Other research has shown that agile manufacturing is dependent upon factors such as the formation of tools/metrics for the virtual enterprise as well as partners, an integrated product/production/business information system, electronic commerce (Gunasekaran, 1998), and the adoption of a common strategic view (Brown and Bessant, 2003). Sanchez and Nahi (2001) noted that cooperativeness and synergy is also needed for the creation of agility, along with responsive creation and delivery of customer-valued, high quality mass customized goods and/or services. Overall the research suggests that agile manufacturing is a unifying umbrella for the firm (Kidd, 1994) emphasizing a systems approach, integrating technology, organization, and people.

In addition to the principal agility enablers discussed above, the literature review revealed several others not commonly found including: the need for a dynamic management system to support continuous change (Bamber *et al.*, 2000), practices that lead to internal and external integration and coordination (Vazquez-Bustelo *et al.*, 2007), people, and collaborative relationships for mastering change and uncertainty (Gehani, 1995; Dahmardeh and Banihashemi, 2010).

The research shows several important benefits resulting from achieving manufacturing agility. The goal of agile manufacturing is to present a solution to customers' needs, not just making a product. Therefore it can be said that agility translates into customer enrichment (Gunasekaran, 1998). Confirming earlier research results (Goldman and Nagel, 1993; Kidd, 1994; Booth, 1995; Hilton and Gill, 1994), Gunasekaran and Yusuf (2002) found that agile manufacturing enables the firm to meet changing market requirements with high quality goods on a consistent basis. Furthermore, agility has been shown to maximize customer service levels while minimizing the cost of goods. Goldman *et al.* (1995) identified similar benefits associated with agile manufacturing such as increased competitiveness and mastery of uncertainty and variability. Other benefits associated with agile manufacturing not previously noted are products and services with high information and value-adding content (Goldman and Nagel, 1993; Goldman *et al.*, 1995) and responsiveness to social and environmental issues (Goldman and Nagel, 1993; Goldman *et al.*, 1995; Kidd, 1994; Vazquez-Bustelo *et al.*, 2007)). The various outcomes associated with agile manufacturing ultimately help organizations "survive and prosper in a competitive environment of continuous and

unpredictable change" (Gunasekaran and Yusuf, 2002, p. 1223).

## Organizational agility

Manufacturing agility represents one of the ways that the firm is able to react and respond to continuous and unanticipated change. Other dimensions of agility at the firm level have also been examined to conceptualize this construct. A review of the literature from the organizational agility perspective provides additional help in building the theoretical base needed for a better understanding of the concept of supply chain agility. Therefore, the articles identified in the previous systematic review were subjected to further analysis to explore the role of agility from an organizational perspective.

Katayama and Bennett (1999) noted that although the concept of agility originated in manufacturing "... the principles of agility can equally apply to other functions of a business and to service industries" (p. 44). The concept has been extended to a number of organizationally-related items including "agile supply chains" (Christopher, 2000; van Hoek *et al.*, 2001; Goldsby *et al.*, 2006; Agarwal *et al.*, 2007; Braunscheidel and Suresh, 2009). The concept of agility from an organizational perspective is still emerging as researchers are continuing efforts to determine its factors or elements (Giachetti *et al.*, 2003).

The various research streams to date have established agility as a very broad and multi-dimensional concept, which has resulted in a number of definitions being put forth. Three perspectives that consistently appear in the literature are: response to change, time (or speed), and the ability to capitalize on change. Goldman *et al.* (1995) described an agile organization as dynamic and able to respond to changing circumstances. Sharifi and Zhang (1999) extended the concept of agility by defining it as turning changes into opportunities. Time-based competitiveness as a dimension of organizational agility was introduced by Kumar and Motwani (1995) in reference to a firm's ability to accelerate activities on a critical path.

Much like the manufacturing agility perspective, some authors define agility as a firm's ability to face and adapt proficiently in a continuously changing and unpredictable business environment, emphasizing the need for organizational capabilities and processes that can quickly handle unanticipated change (Kassim and Zain, 2004; Kodish *et al.*, 1995). Dahmardeh and Banihashemi (2010) confirm the idea that agility is a business-wide capability that allows the firm to use market knowledge to exploit profitable opportunities when volatile conditions exist.

Kidd (1994) characterized an agile organization as a fast moving, adaptable and robust entity. It has been stated that agility is more than a functional capability; as a business-wide capability it impacts organizational structures, information systems, logistics processes and mindsets (Katayama and Bennett, 1999; Power *et al.*, 2001). In terms of outcomes Gehani (1995) defined an agile organization as one that can quickly satisfy customer orders, introduce new products frequently in a timely manner and can get in and out of its strategic alliances speedily.

An often referenced definition of agility provided by Christopher (2000) describes agility as "a business-wide capability that embraces organizational structures, information systems, logistics processes, and, in particular,

mindsets” (p. 37). A main element of the Christopher (2000) definition is similar to manufacturing agility – rapid response to changes in demand. While the term nimble (or quick) is often used to define organizational agility, Christopher (2000) makes the distinction between speed (meeting customer demand in the context of shortened delivery lead times) and agility, which he defines as responding quickly to changes in demand in terms of both volume and variety.

The research on organizational agility primarily focuses on the external dimension of agility. In particular, the emphasis is on the need to satisfy customer demand in turbulent and volatile markets. A great deal of the research on organizational agility discusses this referent and supply chain agility as one and the same. The two, however, are distinct hierarchies. For example, Mentzer *et al.* (2001, p. 4) described a supply chain as “a set of three or 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.” The next section of this paper examines agility from the broader supply chain basis.

## Supply chain agility

### 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 entire supply chain and not just individual members. According to Agarwal *et al.* (2006), “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 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 studies provide formal definitions of supply chain agility (Sharp *et al.*, 1999; Swafford *et al.*, 2006; Ismail and Sharifi, 2006; Li *et al.*, 2008). Many like Christopher (2000) have focused on the identification of characteristics that a supply chain must have in order to be truly agile. 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) proposed a virtual teaming model for supply chain agility. Tolone (2000) suggested 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. Table II presents a summary of definitions of supply chain agility and agility as conceptualized in studies addressing this topic.

### Analysis and interpretation

After reviewing the papers that specifically addressed supply chain agility, each was classified according to its primary perspective. The results presented in Table III indicate that most of the research in the area of supply chain agility has been done through the lens of manufacturing, with most articles exploring the role of manufacturing in achieving supply chain agility. These findings reinforce the importance of the comprehensive review of agile manufacturing conducted earlier in order to fully understand the concept of agility and supply chain agility. Although a few articles address the concept of supply chain agility from a logistics perspective it was done so from a rather narrow functional approach. An example is the research by Baker (2006, 2008), which explored the design of distribution centers for agile supply centers. The results support the need for research that would address the broader role of logistics capabilities in achieving supply chain agility from a holistic conceptual perspective.

### Enablers of agile supply chains

Understanding the enablers of agile supply chains is a very important step in establishing the role of logistics capabilities in achieving this goal. The articles previously identified as addressing supply chain agility were further analyzed with a focus on supply chain agility enablers. An overall assessment shows that much of the early research on supply chain agility has focused on identifying ways to achieve this capability. Christopher (2000) identified three key enablers of supply chain agility including:

- 1 the quality of supplier relationships;
- 2 a high level of shared information; and
- 3 a high level of connectivity between firms in the supply chain.

This last requirement implies exchange of information on demand and inventory levels as well as collaborative working relationships at all levels.

Building on Christopher’s research, van Hoek *et al.* (2001) suggested that in order to be truly agile a supply chain must have knowledge and information about the marketplace and share that information across all supply chain members. A key to achieving supply chain agility is that all members must work together to achieve an integrated supply chain. Agarwal *et al.* (2007) expanded Christopher’s research by identifying a total of fifteen variables that characterize an agile supply chain. While several of the variables are similar to Christopher’s, a number of new characteristics were added that encompassed internal and external aspects such as new product introduction and customer satisfaction. Using interpretive structural modeling to analyze the data, the

Table II Definitions of supply chain agility and agility

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 <i>et al.</i> , 1999	The basis for achieving competitive advantage in changing market conditions
Naylor <i>et al.</i> 1999	Using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace
Sharp <i>et al.</i> , 1999	The ability of a supply chain to rapidly respond to changes in market and customer demand
van Hoek <i>et al.</i> , 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
Aitken <i>et al.</i> , 2002	The ability to have visibility of demand, flexible and quick response and synchronized operations
Conboy and Fitzgerald, 2004	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
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
Swafford <i>et al.</i> , 2006	The supply chain's capability to adapt or respond in a speedy manner to a changing marketplace environment
Jain <i>et al.</i> , 2008	The capability to survive and prosper by reacting quickly and effectively to changing markets
Li <i>et al.</i> , 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

Table III Supply chain agility articles by domain focus, 1991-2010

Domain	Number	Percentage
Manufacturing	21	37
Logistics	8	14
Information technology	6	11
Other	22	38
Total	57	100

results of the Agarwal *et al.* (2007) study indicate that supply chain agility is mainly contingent upon seven factors including: customer satisfaction, quality improvement, cost minimization, delivery speed, new product introduction, service level improvement, and lead time reduction.

Through their extensive review of the research, Lin *et al.* (2006) offer a more comprehensive delineation of supply chain agility. They suggest four categories of supply chain agility enablers including:

- 1 collaborative relationship (strategy);
- 2 process integration (foundation);
- 3 information integration (infrastructure); and
- 4 customer/marketing sensitivity (mechanism).

Relationships, integration and information are enablers that have been noted in other agility research. The last enabler – customer/marketing sensitivity – is a new dimension that entails a supply chain mechanism for sensing and responding

to real customer requirements; providing the capability to deal with change and uncertainty.

Based on the classification above, a supply chain characterized by a high level of collaborative relationships, process integration, information integration, and customer/marketing sensitivity will possess the following distinguishing capabilities or “fitnesses”: responsiveness, competency, flexibility/adaptability, and quickness/speed (Christopher, 2000; Sharp *et al.*, 1999; Giachetti *et al.*, 2003; Jain *et al.*, 2008). These as well as several other common elements are used to describe the concept of supply chain agility. Table IV shows a summary of the descriptors of supply chain agility and the supporting literature base for each.

An underlying theme in the research is the critical role that integration plays in achieving supply chain agility. Previous research has suggested that an integrated supply chain can be considered a dominant competitive advantage in today's business environment (Yusuf *et al.*, 2004). Moreover, the integrated agile supply chain has been argued to be the twenty-first century's enterprise paradigm and the winning strategy to become a national and international leader in an ever-increasing market of fast-changing customer requirements (Yusuf *et al.*, 1999). Yet the ability to build an integrated agile supply chain has developed more slowly than anticipated (Yusuf *et al.*, 2004; Lin *et al.*, 2006).

Li *et al.* (2008, 2009) suggest that business processes and structures, supply chain agility, and performance outcomes

Table IV Common elements in conceptualizing agility

Key element/Description	Authors
<b>Responsiveness</b>	Nagel and Dove, 1991; Goldman <i>et al.</i> , 1994; Gehani, 1995; Booth, 1995; Cho <i>et al.</i> , 1996; Kidd, 1994; Gunasekaran, 1998, 1999; Bullinger, 1999; Sharifi and Zhang, 1999; Sharp <i>et al.</i> , 1999; Christopher, 2000; van Hoek <i>et al.</i> , 2001; Ismail and Sharifi, 2006; Swafford <i>et al.</i> , 2006; Li <i>et al.</i> , 2008
<b>Change as opportunity</b>	Nagel and Dove, 1991; Goldman, 1994; Gehani, 1995; Goldman <i>et al.</i> , 1995; Cho <i>et al.</i> , 1996; Kidd, 1994; Richards, 1996; DeVor <i>et al.</i> , 1997; Gunasekaran, 1998, 1999; Dove, 1999; Naylor <i>et al.</i> , 1999; Sharifi and Zhang, 1999; Yusuf <i>et al.</i> , 1999; Zhang and Sharifi, 2000; Sanchez and Nahi, 2001; Sarkis, 2001; Conboy and Fitzgerald, 2004; Kassim and Zain, 2004
<b>Flexibility</b>	Nagel and Dove, 1991; Booth, 1995; Gupta and Mittal, 1996; Quinn <i>et al.</i> , 1997; Yusuf <i>et al.</i> , 1999; Christopher, 2000; Gunasekaran and Yusuf, 2002; Li <i>et al.</i> , 2008
<b>Customer enrichment/Customization</b>	Nagel and Dove, 1991; Gehani, 1995; Goldman <i>et al.</i> , 1995; Cho <i>et al.</i> , 1996; Kidd, 1994; Bullinger, 1999; Yusuf <i>et al.</i> , 1999; Sanchez and Nagi, 2001; Gunasekaran and Yusuf, 2002
<b>Mobilization of core competencies</b>	Nagel and Dove, 1991; Goldman <i>et al.</i> , 1995; Kodish <i>et al.</i> , 1995; Gupta and Mittal, 1996; DeVor <i>et al.</i> , 1997; Yusuf <i>et al.</i> , 1999; Zhang and Sharifi, 2000; Li <i>et al.</i> , 2008
<b>Integration</b>	Nagel and Dove, 1991; Kidd, 1994; Goldman <i>et al.</i> , 1995; Gupta and Mittal, 1996; Yusuf <i>et al.</i> , 1999; Sanchez and Nagi, 2001; Gunasekaran and Yusuf, 2002; Kassim and Zain, 2004; Li <i>et al.</i> , 2008
<b>Organizational structure</b>	Goldman <i>et al.</i> , 1995; Gupta and Mittal, 1996; DeVor <i>et al.</i> , 1997; Bullinger, 1999; Yusuf <i>et al.</i> , 1999; Sanchez and Nagi, 2001; Gunasekaran and Yusuf, 2002
<b>Speed</b>	Nagel and Dove, 1991; Gehani, 1995; Kodish <i>et al.</i> , 1995; Kumar and Motwani, 1995; Quinn <i>et al.</i> , 1997; Yusuf <i>et al.</i> , 1999; Li <i>et al.</i> , 2008; Cho <i>et al.</i> , 1996; Gehani, 1995; Kidd, 1994; Conboy and Fitzgerald, 2004; Swafford <i>et al.</i> , 2006

are inextricably linked. The core of business processes and structures is distinctive capabilities that consist of attributes, abilities, organizational processes, knowledge, and skills that allow a firm to achieve superior performance (Barney, 1995). It is necessary, therefore, to examine the role that capabilities play in creating supply chain agility. Research has shown that logistics capabilities, specifically, can be used to adapt, integrate and reconfigure resources, organizational skills and functional competencies to achieve superior performance (Morash *et al.*, 1996; Stank and Lackey, 1997; Mentzer *et al.*, 2004). The following section analyzes the current research on logistics capabilities with the objective of establishing a relationship between these capabilities and supply chain agility.

## Logistics capabilities

### Defining logistics capabilities

The term “capabilities” reflects the major role of strategic management in adapting, integrating and reconfiguring resources, organizational skills and functional competencies to respond to the challenges of the external environment. Capabilities, which are complex bundles of skills and accumulated knowledge, determine a company’s capacity of general efficiency and ability (Morash *et al.*, 1996). When they are employed through organizational processes they enable firms to coordinate activities and efficiently use assets (Day, 1994). Morash *et al.* (1996) refer to capabilities as “those attributes, abilities, organizational processes, knowledge, and skills that allow a firm to achieve superior performance and sustained competitive advantage over competitors” (p. 1). It is management’s task to exploit and

leverage firm specific assets and capabilities (Mahoney and Pandian, 1992).

Logistics capabilities, specifically, have been demonstrated to be a source of competitive advantage for the firm (Bowersox *et al.*, 1999; Lynch *et al.*, 2000; Zhao *et al.*, 2001). While the concepts of logistics and supply chain management are related to each other, they have distinct differences. Supply chain management can be viewed as a network of logistics systems and related activities of the individual supply chain members (Coyle *et al.*, 2009). The capabilities of individual logistics systems are a critical part of the success of a supply chain, particularly for time- and quality-based competition (Mentzer *et al.*, 2004).

### Categorizing logistics capabilities

The capability of the logistics system is a critical part of the firm’s success in times of time- and quality-based competition (Mentzer *et al.*, 2004). A review of the research indicates that logistics capabilities can be grouped in a variety of ways. Perhaps one of the most comprehensive examinations of logistics capabilities was conducted by the Global Logistics Research Team at Michigan State University (1995). In-depth interviews and surveys were used to identify seventeen universal logistics capabilities that were subsequently grouped into four competencies: positioning, integration, agility, and measurement.

Morash *et al.* (1996) also conducted a review of logistics capabilities and used two major “value disciplines” (closeness or intimacy and operational excellence) as a way to categorize logistics capabilities. The first value discipline, labeled “demand oriented” emphasizes external dimensions of the customer, customer interfaces, and goals and objectives. Its logistics capabilities are associated with customer service,



time advantages, and responsiveness to markets. The second value discipline, known as the supply-oriented or operations-oriented approach, is related to the firm's operational capabilities and it emphasizes product availability, convenience, and low total distribution cost. In contrast, research by Mentzer *et al.* (2004) explored the role and structure of logistics capabilities in the context of theories of the firm. They conceptualized logistics capabilities that lead to competitive advantage as being in four broad categories:

- 1 demand-management interface capabilities (customer service and logistics quality);
- 2 supply-management interface capabilities (low cost distribution and low cost supply);
- 3 information-management capabilities (information sharing and information technology); and
- 4 coordination capabilities (internal and external).

Stank *et al.* (2005) present a comprehensive, broad classification of logistics capabilities that encompasses four categories that incorporate elements of the two previous classification schemes: customer focus, time management, integration, information exchange, and evaluation. The researchers note that "these capabilities may also represent resource expertise in other functional areas such as manufacturing, marketing, and purchasing. They become key logistics capabilities, however, when they are engendered through movement and storage process activities across the supply chain" (p. 35). Of interest to this research are two of the capabilities: integration and information exchange.

Integration is credited with creating internally interwoven processes that cannot be easily replicated (Daugherty *et al.*, 1998). Stank *et al.* (2005) noted that integration is needed to unify the organization's efforts to meet its goals. Moreover, integration of logistics has been shown to lead to increased firm performance (Kahn and Mentzer, 1996). The authors conceptualize integration as having two essential components: interaction and collaboration. The communication aspects of interdepartmental activities are represented by interaction, while collaboration is portrayed as departments' willingness to work together.

The underlying foundation of an agile supply chain as proposed by Yusuf *et al.* (2004) is integration that allows access to information and data. Information exchange is also a logistics capability that is credited with improved firm performance (Bowersox *et al.*, 1999; Narasimhan and Kim, 2001; Zhao *et al.*, 2001). The ability to gain a distinct competitive advantage in the marketplace has been linked to information exchange by various authors (Deeter-Schmelz, 1997; Glazer, 1991; Porter, 1980; Whipple *et al.*, 2002). The development of appropriate technology as well as behaviors that foster information sharing and connectivity are elements of information exchange (Bowersox *et al.*, 1999).

### Analysis and interpretation

In their review of the relevant research, Esper *et al.* (2007) found that the logistics capabilities most frequently discussed in the literature include: customer-focused capabilities, supply management capabilities, integration capabilities, measurement capabilities, and information exchange capabilities. Using these categories, a summary of the germane studies is presented in Table V.

Three underlying themes are present in the categories of logistics capabilities including efficiency, effectiveness and

differentiation. The demand management capability allows the firm to create product and service differentiation while the supply management capability enables the firm to focus on efficiency. The integration capability ensures that effectiveness is the result of collaborative efforts. To achieve the respective outcomes, information must be exchanged and the results of internal and external operations must be measured to confirm that objectives are being met.

### Linking logistics capabilities and supply chain agility

As stated earlier, a noted result of a varied sampling frame for an integrative literature review is that it can lead to a comprehensive portrayal of complex concepts and theories (Whittemore and Knafl, 2005). The review of the different perspectives on agility indicates that specific logistics elements have been shown to have a direct relationship with this concept. Specifically the assessment of the respective literature bases shows that responsiveness, integration and information capabilities are common themes between the two. Moreover, the agility literature emphasizes a need to be able to react and respond to changing conditions that can be either demand or supply driven. Research on logistics capabilities has shown that they can be regarded as key strategic resources that make it possible for firms to respond in a timely and effective manner to market volatility and/or supply uncertainties (Stank *et al.*, 2005). To date, however, there have been no studies examining the broader relationship of logistics capabilities to achieving agility. This gap suggests a need for a holistic conceptual framework to examine this relationship. There are conceptual aspects that can be used based on previous research, readjusted to the supply chain context, and empirically tested to gain a better understanding of the multi-dimensional phenomenon of agility.

The strategic management literature provides a theoretical framework that can help facilitate the understanding of the impact of logistics capabilities on supply chain agility. The basic premise of Strategy-Structure-Performance (SSP) theory is 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, 1984). While the corporate strategy determines how the firm will compete, it does not establish the approach to be used. This is the function of orientation, which is dependent upon external conditions (Galbraith and Nathanson, 1978; Miles and Snow, 1984). Stank *et al.* (2005) assert that firms will adopt different strategic orientations in response to prevailing conditions.

As the global business environment has become more complex and turbulent, firms have increasingly looked to collaborative organizational structures to gain efficiency and effectiveness (Achrol, 1997). Supply chain orientation (SCO) is "the recognition by a company of the systemic, strategic implications of the activities and processes involved in managing the various flows in a supply chain" (Mentzer *et al.*, 2001, p. 14). As a management philosophy, supply chain orientation recognizes the implications of managing downstream and upstream flows. More importantly, Mentzer *et al.* (2001) assert that companies implementing supply chain management must have a supply chain orientation to achieve the desired outcomes. Because the SSP strategic planning paradigm indicates that the strategic orientation chosen by the

Table V Research summary of logistics capabilities

Capability <sup>a</sup>	Description	Authors
<b>Demand-management capability</b>	Product or service differentiation; service enhancement for continuous distinctiveness by targeting a given customer base; unique, value-added activities	Morash <i>et al.</i> , 1996; Stank and Lackey, 1997; Bowersox <i>et al.</i> , 1999; Lynch <i>et al.</i> , 2000; Zhao <i>et al.</i> , 2001; Mentzer <i>et al.</i> , 2004; Esper <i>et al.</i> , 2007
<b>Supply-management capability</b>	Total system cost minimization with explicit consideration of cross-functional trade-offs; effective management of time to eliminate wasted capital and inventory; response to demand fluctuations with less distortion of the order cycle process; use of resources to enable postponement speculation, modularization, and standardization	Murphy and Farris, 1993; McGinnis and Kohn, 1993; Daugherty and Pittman, 1995; Morash <i>et al.</i> , 1996; Mentzer <i>et al.</i> , 2001; Lowson, 2003; Esper <i>et al.</i> , 2007
<b>Integration capability</b>	A state that exists among internal organizational elements that are necessary to achieve unity of effort to meet organizational goals; includes internal and external components	Kahn and Mentzer, 1996; Daugherty <i>et al.</i> , 1998; Bowersox <i>et al.</i> , 2003; Stank <i>et al.</i> , 2005; Esper <i>et al.</i> , 2007
<b>Measurement capability</b>	Degree to which a firm monitors internal and external operations; aligned with strategy to make accurate, detailed, relevant, and timely information accessible for strategic planning and daily decision making; enables the translation of business objectives into measurement specific operational and financial targets	Global Logistics Research Team, Michigan State University, 1995; Fawcett <i>et al.</i> , 1997; Gilmour, 1999; Bowersox <i>et al.</i> , 2000; Holmberg, 2000; Esper <i>et al.</i> , 2007
<b>Information exchange capabilities</b>	Acquires, analyzes, stores, and distributes tactical and strategic information both inside and outside the firm; involves the application of hardware, software and networks	Closs <i>et al.</i> , 1997; Zhao <i>et al.</i> , 2001; Mentzer <i>et al.</i> , 2004; Esper <i>et al.</i> , 2007; Jack <i>et al.</i> , 2009

Source: <sup>a</sup>Classification criteria adapted from Esper *et al.* (2007)

firm determines the structure that is used to coordinate functions and processes, it is surmised that SCO establishes the approach that the firm will take in developing logistics capabilities.

#### Establishing the relationship between logistics capabilities and supply chain agility

For purposes of developing a conceptual model to explore the relationship of logistics capabilities to supply chain agility, the categorization of logistics capabilities suggested by Mentzer *et al.* (2004) is used. It is also necessary to denote that logistics capabilities have both internal and external dimensions. Internally, logistics has to work closely with other functions to plan, coordinate, and integrate cross-functional activities (Bowersox *et al.*, 1999; Morash *et al.*, 1996). From a strategic perspective, logistics has the ability to coordinate and integrate interdependent activities across major functional areas (Langley and Holcomb, 1992). Consequently, logistics personnel have the unique capability to actively coordinate with other functions inside the company. Externally, by expanding logistics beyond the firm structure to include customers and suppliers, logistics can generate benefits such as asset productivity, operational effectiveness, and enhanced customer value (Langley and Holcomb, 1992). Given its unique role, logistics can create a firm's supply chain capability by linking systems and operational interfaces to reduce redundancy while maintaining operational synchronization (Mentzer *et al.*, 2004).

#### The moderating effect of coordination and cooperation

The literature suggests that internal and external coordination capabilities contribute to process integration and the development of collaborative relationships within the supply chain. Coordination entails the alignment of actions between participating parties. Coordination is often difficult because of lack of shared and accurate knowledge about the decision rules that others are likely to use and how one's own actions are interdependent with those of others (Malmgren, 1961; Geanakoplos, 1992; Gulati and Khanna, 1994). Coordination problems can still arise even when cooperation is achieved (aligned interests). Incentives, sanctions, monitoring, rewards, and punishments can help to achieve cooperation but are not sufficient to achieve coordination (Gulati and Singh, 1998). This is due to the fact that cooperation problems are rooted in motivation, while coordination problems are due to cognitive limitations of parties. These limitations deny parties the comprehensive knowledge of how others will behave in situations of interdependence, and how they will act interdependent with others. For that reason it is proposed that coordination has a moderating effect on the degree to which firm-specific logistics capabilities become integrated supply chain logistics capabilities.

Cooperation (alignment of interests) and coordination (alignment of actions) are many times used interchangeably despite scholars' efforts to emphasize the differences between the two. Cooperation entails the alignment of interest between participating parties, which is often difficult because individuals/firms are often driven by the achievement of private benefits at the expense of collective benefits. It is impossible to achieve a state of integrated supply chain

logistics capabilities without cooperation at all levels within the firm and among the firms that constitute a supply chain (Heide and Miner, 1992; Yusuf *et al.*, 1999).

### Synthesis and integration of the concepts

The literature review on agility established several characteristics of an agile supply chain that can be directly or indirectly linked to logistics capabilities. These include items such as lead time (Christopher and Towill, 2001), delivery speed and reliability (Jayaram *et al.*, 1999; Power *et al.*, 2001), service level and cost (Agarwal *et al.*, 2006), and information/data sharing (Gunasekaran, 1998). Supply chain agility, however, cannot be achieved within individual firms alone (Christopher, 2000; Christopher and Towill, 2001). Firms must “work together to achieve a level of agility beyond the reach of individual companies” (Lin *et al.*, 2006, p. 285–286) suggesting that it is not enough for firms to develop individual firm specific logistics capabilities in order to enhance supply chain agility. It is the premise of this research that true supply chain agility can only be achieved when logistics capabilities are integrated at the supply chain level.

The literature supports an integration of the various perspectives and it provides a sufficient theoretical basis for formulating a holistic conceptual perspective to examine the relationship of these two constructs. Figure 1 presents that synthesis of the literature in the form of a conceptual framework regarding the relationship between logistics capabilities and supply chain agility.

### Conclusion

The concept of agility has been noted as a means for handling change, increasing customer responsiveness, and mastering market turbulence. Moreover, agility has been regarded as a necessary ingredient for improving firm competitiveness through the use of market knowledge to exploit profitable opportunities in a volatile environment. In an era of global business where companies no longer compete against each other as autonomous entities, but instead as supply chain

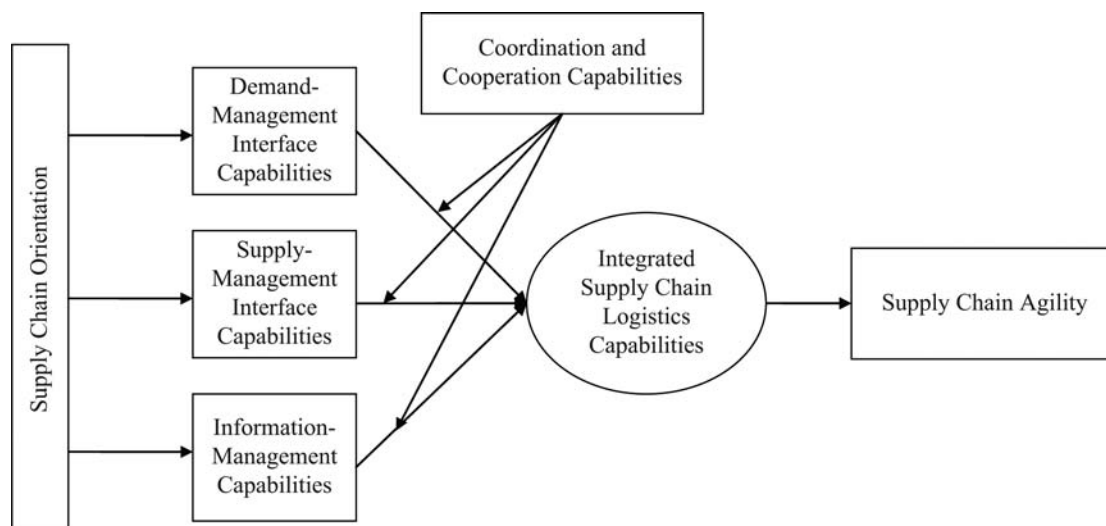
against supply chain, agility is a critical capability for survival and competitiveness.

Supply chain agility has primarily been explored in the literature through a focus on manufacturing flexibility, speed, or lean manufacturing. This level of understanding is not sufficient as companies increasingly need to respond efficiently and effectively to volatility and uncertainty that can emanate from any part of their supply chain. The review of the literature shows that theories of supply chain agility are beginning to emerge. There is no unified conceptualization of the concept and the dimensions of agility presented to date are fairly limited (Li *et al.*, 2009). Furthermore, the role of capabilities, and specifically logistics capabilities, in achieving supply chain agility has not been explored in the research. This research addresses that gap through an extensive systematic review of the literature on agility in manufacturing, organizations and supply chains. The body of research on logistics capabilities is also examined. The various perspectives are integrated to develop a holistic conceptual framework that links logistics capabilities to supply chain agility.

A main contribution of this research is the comprehensive review and assessment of the agility literature using a multi-disciplinary approach. The various aspects, as well as enablers of agility, are explored revealing the complexity of this multi-dimensional concept. Supply chain agility is a relatively new phenomena and theory development will be an important contribution to understanding the concept. The next phase for this research is to aid in theory building through the operationalization of constructs proposed by the conceptual framework and then empirically testing the hypothesized relationships. The systematic review and synthesis of the research bases on agility and logistics capabilities provides an important foundation for future empirical examination for understanding the relationship between these complex concepts.

In addition to the theoretical contribution, the role of logistics capabilities in creating supply chain agility has managerial implications. Agility in the supply chain has been shown to increase the speed and flexibility with which activities can be accomplished. The process of moving goods

**Figure 1** Conceptualizing the relationship between logistics capabilities and supply chain agility





from a customer order through supply, production, and distribution of products to the customer requires logistics capabilities that can respond to constantly changing conditions, including final customer demand. Furthermore, because the level of agility in a supply chain can determine the efficiency and effectiveness of the collective efforts, it is essential that firms become more knowledgeable about the role of logistics capabilities in achieving agility.

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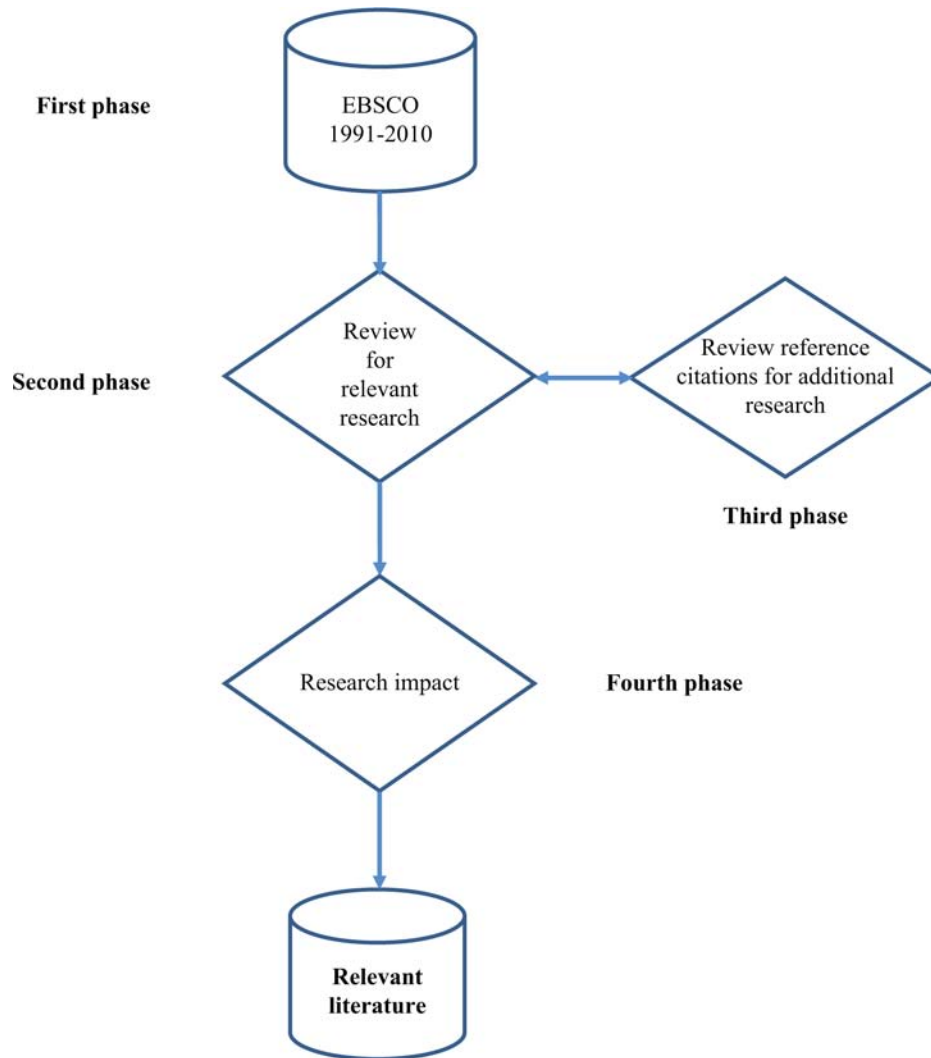
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## Appendix

**Figure A1** Generalized process for data collection



### About the authors

David M. Gligor has a BS in logistics from The University of Tennessee (UT) and a MBA from Kennesaw State University. He is currently a PhD student at The University of Tennessee, Knoxville. Prior to joining the logistics PhD program at UT he has worked for companies such as General Electric, Ryder Integrated Logistics, and Hapag-Lloyd.

Mary C. Holcomb is Associate Professor of Logistics at the University of Tennessee. In addition to her academic career, her professional career involved some 18 years at the Oak Ridge National Laboratory in transportation research and policy issues. Mary C. Holcomb is the corresponding author and can be contacted at: mholcomb@utk.edu