IJMR INTERNATIONAL JOURNAL OF MANAGEMENT REVIEWS
British Academy of Management
International Journal of Management Reviews, Vol. 00, 1–30 (2016)
DOI: 10.1111/ijmr.12096

Understanding and Development of Supply Chain Agility and Flexibility: A Structured Literature Review

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This paper provides a review of the literature while contributing to academic understanding of the concepts of agility and flexibility within the supply chain. The research identified 83 peer-reviewed articles through a structured review technique, which is based on a three-stage refinement process. Data reduction procedures using codification, sentence strings and a review of keywords, title, abstract and conclusion were used in the search. The papers identified focused on organizational and supply chain agility and flexibility. The acknowledged gaps in understanding and development of agility and flexibility in supply chains were identified and categorized in terms of conceptual, contextual and methodological gaps. Subsequent to the gap analysis, this paper argues that effective relationship integration with key partners is a fundamental mechanism for mitigating the problem of control dissipation, which has hindered academic understanding with respect to development and application of agile and flexible capabilities in supply chains. The findings in this paper will help academics to gain a better understanding and to develop the concepts of supply chain agility and flexibility. In addition, the findings indicate that supply chain stakeholders need to address the issue of relationship integration when undertaking, or participating in agility and flexibility development programmes, so as to maximize supply chain performance. The paper concludes by highlighting implications for managers and researchers, and proposes a number of areas for future investigation.

Introduction

Different types of uncertainty and change demand different capabilities for effective and efficient organizational responses (McCann 2004; Purvis *et al.* 2014). These responses have been linked to the strategic capabilities of agility and flexibility, with the research focused on the functions and processes of the organization and, more recently, the supply chain (Dove 1996; Ngai *et al.* 2011). In spite of this, the literature does not provide useful guidelines and examples of what actually constitutes organizational and supply chain capability, or how companies use these capabilities to manage and influence their relationships (Flynn and Flynn 2004; Gligor *et al.* 2015; Rosenzweig and Roth 2004).

According to Wadhawa and Rao (2003) there is a dichotomous view of how agility and flexibility occurs; many researchers view agility as composed of a number of core elements centring on flexibility (Prater *et al.* 2001; Sharifi and Zhang 1999; Vernadat 1999), while others see agility as an *extension* of flexibility (Backhouse and Burns, 1999; Richter *et al.* 2010; Tan 1998; Vokurka and Fliedner 1998). Confusion also occurs because of the interchangeable use of the terms within the literature, as noted by Bernardes and Hanna (2009); whereby both terms may be used to describe the same situation or set of circumstances (Li *et al.* 2010; Yi *et al.* 2011).

Only a limited number of studies have specifically researched the differences that exist between agility and flexibility and their interaction within the supply chain (e.g. Baker 1996; Bernardes and Hanna 2009; Charles *et al.* 2010; Wadhawa and Rao 2003). The discrepancies in terminology application exist because neither term has been comprehensively defined in the literature that surrounds supply chain management (Gligor and Holcomb 2012b). The authors argue that this is a serious impediment to academic understanding, as it creates an inaccurate purview of the processes that are in play, or need to be managed.

Drawing from a structured review, this paper addresses the dichotomy by providing an explanation of how the concepts of agility and flexibility are used and defined within supply chains. The review, based on 83-refereed articles sourced from electronic databases, addresses the following research question: How can agility and flexibility be better understood and developed within supply chains? The review of the literature presented in this paper differs from previous studies with respect to its aim, scope, approach, methodology and contribution, which is much more comprehensive than in previously published articles.

The review of the literature, as guided by the research question, led to the identification of three categories of research gap:

- conceptual (areas of difference; agility and flexibility)
- contextual (unit of analysis; organizational and supply chain)
- methodological (choice of methods; case study and modelling).

This paper presents a discussion focusing specifically on the supply chain, which identifies the importance of relationship dynamics for understanding and developing agility and flexibility (e.g. Braunscheidel and Suresh 2009; Christopher 2000; Kisperska-Moron and Swierczek 2009; Li *et al.* 2008; Ngai *et al.* 2011; Swafford *et al.* 2006; Yusuf *et al.* 1999; Zhang 2011). The imperfections associated with control proficiency in the supply chain are explained and used to support calls for stronger relationship integration in supply chain environments. It is argued that relationship integration is influential in mitigating potential problems relating to inter-organizational engagement, which can hinder both agility and flexibility. This study uses the following definitions grounded in the work of Fayezi *et al.* (2015):

- Supply chain agility: a *strategic* ability that assists organizations rapidly to sense and respond to internal and external uncertainties via effective integration of supply chain relationships.
- Supply chain flexibility: an *operational* ability that assists organizations to change efficiently internally and/or across their key partners in response to internal and external uncertainties via effective integration of supply chain relationships.

One of the paper's contributions focuses on updating the literature concerning the importance of agility and flexibility in supply chains, and how these two concepts have evolved and are now central to organizational planning and operational practice. Importantly, the authors highlight that supply chain agility and flexibility, while related to organizational agility and flexibility, are actually different concepts in terms of the key drivers and operational focus. The discussion presented in this paper provides greater clarity concerning the respective terms and the role that each concept plays within the supply chain. This has also been addressed through developing the definitions of supply chain agility and flexibility above via a structured review of the literature.

The paper is organized as follows. The methodology is discussed first; it explains the methods used to collect and analyse data for the purpose of a structured review of the literature. This is followed by a review of the agility and flexibility literature relating to both organizations and supply chains. Important gaps within the literature are identified and discussed in relation to conceptual, contextual and methodological categories. Concluding remarks, contributions and implications for theory and practice are discussed in the final section of the paper.

Methodology

The method employed in this paper is secondary data collection and analysis using documentary research techniques (Platt 1981). The authors have adopted a structured process for selection of the appropriate literature, which is consistent with similar review studies undertaken by, for example, Burgess *et al.* (2006), Giunipero *et al.* (2008) and Vanany *et al.* (2009). The strategy employed seeks to identify the relevant information through a coded evaluation process in order to identify the articles. A three-stage refinement process using data reduction procedures (e.g. title, keywords, abstract and conclusion) has

been used. The literature review was undertaken using the following databases; Emerald, ScienceDirect and ABI/Inform Global Proquest.

In the first stage, keywords and sentence strings – 'agility', 'flexibility', 'organizational agility/flexibility', 'supply chain agility/flexibility' and 'supply chain responsiveness' – were employed to identify the literature. The results obtained from each database (using different combinations of the keywords) were then cross-compared for possible overlaps, placed into keyword files and checked for duplication. This stage was restricted to refereed journal articles only, so as to maintain reliability and validity in reporting.

The second stage of the process involved reviewing and screening the articles. This involved conducting an initial check with regard to the titles and keywords identified in the articles. From this, a total of 95 papers were identified. The third stage entailed reviewing the abstracts and conclusions of all 95 articles. This reduced the number of articles to 83 (out of 95). These articles were then grouped according to their primary focus – either agility or flexibility – and whether they discussed agility and flexibility in terms of the organization and/or supply chain. Stages 1–3 were performed manually, and a spreadsheet database was built, with a search and crosscheck function to ensure criteria compliance.

The final 83 articles form the basis of the structured review of the literature presented across the paper (see Tables 2 and 4). These articles have been used to answer the research question and recommend areas for future research. Table 1 shows the journal details of these articles.

To assist with the data analysis, an instrument for collecting key information from within each of the 83 articles was designed and implemented. Key areas included, but were not limited to, organizational/supply chain agility, organizational/supply chain flexibility, author(s), year, title, journal, methodology and objective(s) (see Tables 2 and 4). This information was then used to identify the main themes relating to agility and flexibility, highlight any gaps in the literature and, finally, draw out a number of important implications for managing agility and flexibility.

Organizational and supply chain agility

This section provides an overview of the organizational and supply chain agility literature (see Table 2). The rationale for including organizational agility as part of this study is based on an acknowledgement of the importance of the relationship that exists between an organization and its supply chains.

Organizational agility

Current understanding of organizational agility has its origins firmly located within manufacturing. Extensive research on agile manufacturing (see, for example, DeVor *et al.* 1997; Gunasekaran 1998 1999; Sharifi and Zhang 2001; Yusuf *et al.* 1999; Zhang 2011) has been a key influence regarding investigation in other areas of agility. Additional contributions to the agility debate emanate from workforce analysis (e.g. Qin and Nembhard 2010) and information technology (Overby *et al.* 2006). A detailed review of the literature confirms that agility is understood to be a multidimensional concept influencing, for example, the strategic and operational focus of an organization and its interaction with supply chain partners (Jin-Hai *et al.* 2003; Sanchez and Nagi 2001; Sherehiy *et al.* 2007).

The knowledge base surrounding organizational agility has developed in a variety of different ways and focuses on, for example, agility dimensions, enablers, drivers and practices. This is best illustrated in Bessant *et al.*'s (2002) reference model for agility development, which seeks to explain behavioural routines across an organization's operational procedures and structures. The behavioural routines ranged from scanning, strategic thinking and problem-solving, to networking, structuring and continuous learning (see Bessant *et al.* 2002, p. 490, for the complete list). Bessant *et al.*'s (2002) study is important because it highlights the complexity and multidimensional nature of agility development both within and external to the organization.

Organizational agility is composed of the following dimensions: quickness, proactiveness, responsiveness, adaptiveness, cooperation, flexibility and information system/technology (see, for example, Gunasekaran 1998; McCann *et al.* 2009; Sharifi and Zhang 1999; Vázquez-Bustelo *et al.* 2007; Yusuf *et al.* 1999; Zhang 2011). Conceptually, the dimensions of agility have been constructed from an amalgamation of directly related factors (see Table 3) in which, for example, quickness underpins speed, time and the rapid introduction of new products. Importantly, these dimensions, if managed correctly, are capable of enhancing an organization's level of agility and subsequently contributing to its prosperity during periods of turbulence (Zhang 2011).

Table 1. Journal names and article numbers

Name of journal	Number of articles
(a) Journal names and article numbers related to agility	
International Journal of Production Economics	8
International Journal of Operations & Production Management	6
Industrial Marketing Management	3
Journal of Operations Management	3
International Journal of Agile Systems and Management	2
International Journal of Production Research	2
Supply Chain Management: An International Journal	2
Business Process Management Journal	1
California Management Review	1
European Journal of Information Systems	1
European Journal of Operational Research	1
Harvard Business Review	1
IIE Transactions	1
International Journal of Accounting Information Systems	1
International Journal of Contemporary Hospitality Management	1
International Journal of Industrial Ergonomics	1
International Journal of Logistics Management	1
International Journal of Physical Distribution & Logistics Management	1
International Journal of Technology Management	1
Industrial Management & Data Systems	1
Journal of Business Logistics	1
Journal of Business Research	1
Journal of Enterprise Information Management	1
Journal of Knowledge Management	1
Journal of Strategic Information Systems	1
Management Decision	1
MIS Quarterly	1
People & Strategy	1
Technovation	1
Total	**48**
(b) Journal names and article numbers related to flexibility	
Journal of Operations Management	6
International Journal of Production Economics	5
International Journal of Operations & Production Management	4
International Journal of Production Research	3
Industrial Marketing Management	2
Journal of Business Research	2
AIIE Transactions	1
APICS Production & Inventory Management Journal	1
California Management Review	1
International Journal of Agile Management Systems	1
International Journal of Business Excellence	1
Industrial Management & Data Systems	1
Journal of Business Logistics	1
Journal of Organizational Change Management	1
Journal of Supply Chain Management	1
Management Science	1
Omega: The International Journal of Management Science	1
Strategic Management Journal	1
Technovation	1
Total	**35**

The authors' review and analysis of the agility dimensions shows that these dimensions (see Table 3) can be broadly categorized into change expectancy and change response. Change expectancy refers to an organization's ability to sense changes in the external environment, and how these changes affect the internal dynamics of the organization (Fayezi *et al.* 2015). Proactiveness, responsiveness and

Table 2. Organizational and supply chain agility articles

	Author(s)	Year	Title	Journal	Methodology	Objective(s)
				Organizational agility		
1	DeVor, Graves and Mills	1997	Agile manufacturing research: accomplishments and opportunities	IIE Transactions	Conceptual	To discuss the genesis of several of the Agile Manufacturing Research Institutes and their ongoing activities and results to date.
2	Fisher	1997	What is the right supply chain for your product	Harvard Business Review	Conceptual	To develop a conceptual framework which assists managers in identifying the right supply chain strategy based on their type of products.
3	Gunasekaran	1998	Agile manufacturing: enablers and an implementation framework	International Journal of Production Research	Conceptual	To present: • a comprehensive analysis of agile manufacturing concepts, from both a strategic perspective and enablers points of view in order to motivate the researchers and practitioners in agile manufacturing research and applications. • a framework for the development of the agile manufacturing system.
4	Gunasekaran	1999	Agile manufacturing: a framework for research and development	International Journal of Production Economics	Conceptual	• To identify key strategies and techniques of agile manufacturing. • To suggest some future research directions. • To develop a framework for the development of agile manufacturing systems along four key dimensions which include strategies, technologies, systems and people.
5	Yusuf, Sarhadi and Gunasekaran	1999	Agile manufacturing: the drivers, concepts and attributes	International Journal of Production Economics	Conceptual	• To present a comprehensive definition of agility which can be adopted as a working definition by practitioners. • To identify underlining driver, concepts and attributes of agility.
6	Sharifi and Zhang	1999	A methodology for achieving agility in manufacturing organizations: an introduction	International Journal of Production Economics	Survey	• To discuss the concepts and the development of a methodology to achieve agility based on them. • To provide a practical self-assessing model that could be used as a tool for manufacturing companies in attempt to becoming agile.
7	Dove	1999	Knowledge management, response ability, and the agile enterprise	Journal of Knowledge Management	Conceptual	To conceptualize agility from knowledge management perspective.
8	Sharifi and Zhang	2001	Agile manufacturing in practice: application of a methodology	International Journal of Operations & Production Management	Case studies	To provide a brief summary of the methodology for achieving agility and detail its implementation and validation.

Table 2. Continued

	Author(s)	Year	Title	Journal	Methodology	Objective(s)
				Organizational agility		
9	Sanchez and Nagi	2001	A review of agile manufacturing systems	International Journal of Production Research	Conceptual	To review a wide range of existing literature on agile manufacturing systems; to propose a classification scheme for those papers, and; to identify areas where further research is needed.
10	Bessant, Knowles, Briffa and Francis	2002	Developing the agile enterprise	International Journal of Technology Management	Multiple case study (action research)	Presents a reference model that explains and guides the development of agility in small and medium-sized manufacturing organizations.
11	Lee	2002	Aligning supply chain strategies with product uncertainties	California Management Review	Conceptual	To expand Fisher's (1997) supply chain strategy framework to include supply uncertainties in addition to the type of product.
12	Jin-Hai, Anderson and Harrison	2003	The evolution of agile manufacturing	Business Process Management Journal	Conceptual	To explore the evolution of agile manufacturing to improve understanding of the process and content of agile manufacturing.
13	Sambamurthy, Bharadwaj and Grover	2003	Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms	MIS Quarterly	Conceptual	To broaden understanding of the strategic role of information technology by examining the nomological network of influences through which information technology impacts firm performance.
14	Narasimhan, Swink and Kim	2006	Disentangling leanness and agility: an empirical investigation	Journal of Operations Management	Survey	• To address the content of lean manufacturing and agile manufacturing with a view to adding clarity to the discussion in the literature relating to these paradigms. • To carry out an exploratory study to establish, empirically, the usefulness of lean manufacturing and agile manufacturing paradigms in describing actual differences in practice–performance groupings of manufacturing plants.
15	Overby, Bharadwaj and Sambamurthy	2006	Enterprise agility and the enabling role of information technology	European Journal of Information Systems	Conceptual	To provide a foundation for research on enterprise agility and the role of information technology in enabling agility.
16	Vázquez-Bustelo and Avella	2006	Agile manufacturing: industrial case studies in Spain	Technovation	Multiple case study	To analyse the drivers, practices and results of agility in order to offer an initial approach to agile manufacturing.
17	Sherehiy, Karwowski and Layer	2007	A review of enterprise agility: concepts, frameworks, and attributes	International Journal of Industrial Ergonomics	Conceptual	To identify the origins and theoretical background of some ideas implemented in the agile enterprise field in order to clarify the ambiguity of the concept, and categorize the large variety of concepts, strategies and practices described in the literature as a part of agility.

18	Vázquez-Bustelo, Avella and Fernández	2007	Agility drivers, enablers and outcomes: empirical test of an integrated agile manufacturing model	International Journal of Operations & Production Management	Survey	To analyse agile manufacturing in Spain and study whether it is a critical factor for success in different industries.
19	Hallgren and Olhager	2009	Lean and agile manufacturing: external and internal drivers and performance outcomes	International Journal of Operations & Production Management	Survey	To investigate internal and external factors that drive the choice of lean and agile operations capabilities and their respective impact on operational performance.
20	McCann, Selsky and Lee	2009	Building agility, resilience and performance in turbulent environments	People & Strategy	Survey	To examine what measures of agility and resiliency specifically relate to organization performance and how varying levels of turbulence impact those relationships.
21	Asree, Zain and Razalli	2010	Influence of leadership competency and organizational culture on responsiveness and performance of firms	International Journal of Contemporary Hospitality Management	Survey	To investigate the operations strategy of service firms (Hotels) in order to determine whether the infrastructural aspects of their operational practices, i.e. leadership competency and organizational culture, would affect their responsiveness (as a cumulative capability) to their employees and customers and eventually their performance (increase in revenue).
22	Qin and Nembhard	2010	Workforce agility for stochastically diffused conditions: a real options perspective	International Journal of Production Economics	Modelling	To develop a better understanding of workforce agility in a stochastically diffused environment, wherein a new product spreads into the market and has a limited life cycle, using real options valuation.
23	Ribeiro and Fernandes	2010	Exploring agile methods in construction SMEs: a case study	Journal of Enterprise Information Management	Case studies	To examine the management methodologies and tools adopted by SMEs in an organizational context and draws conclusions relating to the adoption of agile values and methods for enhancing their business capacity.
24	Raschke	2010	Process-based view of agility: the value contribution of IT and the effects on process outcomes	International Journal of Accounting Information Systems	Survey	To examine the value contribution of information technology by understanding the components of agility at the process level.
25	Zelbst, Green, Abshire and Sower	2010	Relationships among market orientation, JIT, TQM and agility	Industrial Management & Data Systems	Survey	To investigate the adoption of a market orientation coupled with implementation of just-in-time, total quality management and agile improvement programmes within manufacturing organizations from a macro perspective., using systems theory as the theoretical underpinning.

Table 2. Continued

	Author(s)	Year	Title	Journal	Methodology	Objective(s)
				Organizational agility		
26	Zhang	2011	Towards theory building in agile manufacturing strategies: case studies of an agility taxonomy	International Journal of Production Economics	Case studies	To establish why companies choose each type of strategy, what distinctive agility drivers they are faced with and why, and whether and what typical action programmes are used to implement the strategies.
27	Hasan, Sarkis and Shankar	2013	Interpretive structural modelling of agility enhancing management practices for agile manufacturing	International Journal of Agile Systems and Management	Modelling	To evaluate the relationships and linkages of agility enhancing management practices in order further to understand and advance research in agility and agile manufacturing.
				Supply chain agility		
1	Christopher	2000	The agile supply chain: competing in volatile markets	Industrial Marketing Management	Conceptual	To conceptualize the supply chain agility, make it distinguishable from the concept of leanness.
2	Power, Sohal and Rahman	2001	Critical success factors in agile supply chain management	International Journal of Physical Distribution & Logistics Management	Survey	To identify and understand key leverage points when seeking to create an agile supply chain.
3	Van Hoek, Harrison and Christopher	2001	Measuring agile capabilities in the supply chain	International Journal of Operations & Production Management	Survey + Case study	To establish an audit of agility in the supply chain (the audit is used in an empirical investigation of agile capabilities in Europe).
4	Handfield and Bechtel	2002	The role of trust and relationship structure in improving supply chain responsiveness	Industrial Marketing Management	Survey	To develop and test a model that addresses the following question: how can purchasing managers structure relationships with suppliers to achieve a desired outcome (supply chain responsiveness), given varying degrees of dependence on suppliers and different market channel forms?
5	Yusuf, Gunasekaran, Adeleye and Sivayoganathan	2004	Agile supply chain capabilities: determinants of competitive objectives	European Journal of Operational Research	Survey	To explore the relationship between the emerging patterns in supply chain integration and attainment of competitive objectives.

6	Mathiyalakan	2006	Research issues in agile supply chain management	International Journal of Agile Systems and Management	Conceptual	To review literature on agile supply chain, develop a framework for organizing the existing research, and identify issues for further research.
7	Swafford, Ghosh and Murthy	2006	The antecedents of supply chain agility of a firm: scale development and model testing	Journal of Operations Management	Survey	To identify and develop critical factors that determine and influence an organization's supply chain agility.
8	Lin, Chiu and Chu	2006	Agility index in the supply chain	International Journal of Production Economics	Modelling	To develop a fuzzy agility index based on agility providers, using fuzzy logic.
9	Baramichai, Zimmers Jr and Marangos	2007	Agile supply chain transformation matrix: an integrated tool for creating an agile enterprise	Supply Chain Management: An International Journal	Modelling	To propose a tool, the Agile Supply Chain Transformation Matrix, and the implementation methodology for a systematic approach to achieve agility in the supplier–buyer supply chain.
10	Hoyt, Huq and Kreiser	2007	Measuring organizational responsiveness: the development of a validated survey instrument	Management Decision	Survey	To develop a survey instrument as a data collection tool for the study of organizational responsiveness.
11	Swafford, Ghosh and Murthy	2008	Achieving supply chain agility through IT integration and flexibility	International Journal of Production Economics	Survey	To understand better the direct and indirect relationships among information technology integration, supply chain flexibility, supply chain agility and competitive performance.
12	Braunscheidel and Suresh	2009	The organizational antecedents of a firm's supply chain agility for risk mitigation and response	Journal of Operations Management	Survey	To investigate the impact of two cultural antecedents, market orientation and learning orientation, and three organizational practices, all aimed at augmenting the supply chain agility of a firm.
13	Squire, Cousins, Lawson and Brown	2009	The effect of supplier manufacturing capabilities on buyer responsiveness: the role of collaboration	International Journal of Operations & Production Management	Survey	To examine the relationships between supplier capabilities, supply chain collaboration and buyer responsiveness.
14	Kisperska-Moron and Swierczek	2009	The agile capabilities of Polish companies in the supply chain: an empirical study	International Journal of Production Economics	Survey	To explore the main agile capabilities of Polish companies in supply chains.
15	Li, Goldsby and Holsapple	2009	Supply chain agility: scale development	International Journal of Logistics Management	Survey	To develop an instrument to measure supply chain agility.

Table 2. Continued

	Author(s)	Year	Title	Journal	Methodology	Objective(s)
				Supply chain agility		
16	Ngai, Chau and Chan	2011	Information technology, operational, and management competencies for supply chain agility: findings from case studies	Journal of Strategic Information Systems	Case study	Using resource-based view developed a conceptual framework which demonstrated the strategic stance of supply chain competencies across information technology, operations and management for developing and maintaining supply chain agility that result in better organizational performance.
17	Chen and Chiang	2011	Network agility as a trigger for enhancing firm performance: a case study of a high-tech firm implementing the mixed channel strategy	Industrial Marketing Management	Case studies	To broaden understanding about the strategic role of a mixed-method channel strategy and about the influence of network agility by conducting a qualitative case study involving channel systems in the optical storage media industry.
18	Gligor and Holcomb	2012a	Antecedents and consequences of supply chain agility: establishing the link to firm performance	Journal of Business Logistics	Survey	• To address the gap that currently exists in the literature regarding the role that inter-firm behavioural elements play in enabling supply chain agility. • To examine the relationship between supply chain agility and firm performance, specifically operational and relational results.
19	Roberts and Grover	2012	Investigating firm's customer agility and firm performance: the importance of aligning sense and respond capabilities	Journal of Business Research	Survey	• To conceptually define and operationalize firm's customer agility. • To investigate the extent to which alignment between sensing and responding capabilities affects performance.
20	Qrunfleh and Tarafdar	2013	Lean and agile supply chain strategies and supply chain responsiveness: the role of strategic supplier partnership and postponement	Supply Chain Management: An International Journal	Survey	To examine the role of strategic supplier partnership and postponement respectively, on the relation between lean and agile supply chain strategy and supply chain responsiveness.
21	Fayezi, Zutshi and O'Loughlin	2015	How Australian manufacturing firms perceive and understand the concepts of agility and flexibility in the supply chain	International Journal of Operations & Production Management	Case studies	To addresses an important question that centres on investigating how manufacturing businesses perceive and understand the concepts of agility and flexibility in their supply chains.

Total: 48 articles

Table 3. Summary of key themes relating to the dimensions of organizational agility

Category	Elements	Sample references
Quickness	Speed, time, quick new product introduction	Sharifi and Zhang 1999, 2001; Yusuf *et al.* 1999
Proactiveness	Opportunity seeking, long-term success	Christopher 2005; McCann *et al.* 2009; Yusuf *et al.* 1999; Zhang 2011
Responsiveness	Sensing, anticipating change, initiating/responding to change	Bessant *et al.* 2002; Overby *et al.* 2006; Raschke 2010; Sharifi and Zhang 1999
Adaptiveness	Investment in people, change management, rapid change	Asree *et al.* 2010; Gunasekaran 1998; Gunasekaran 1999; Hasan *et al.* 2013; Lee 2002; Raschke 2010; Vázquez-Bustelo *et al.* 2007
Cooperation	Internal integration, technology-mediated relationship	Christopher 2005; Gunasekaran 1998, 1999; Vázquez-Bustelo *et al.* 2007; Zhang 2011
Flexibility	Scope, time and cost, re-configurability	Bessant *et al.* 2002; Dove 1996; Qin and Nembhard 2010; Sharifi and Zhang 1999; Yusuf *et al.* 1999
Information system/technology	Knowledge management, information technology	Dove 1999; Gunasekaran 1999; Overby *et al.* 2005, 2006; Sambamurthy *et al.* 2003

information system/technology contribute to the ability of organizations to sense and understand changes when dealing with their various stakeholders. Change expectancy has evolved through the development of both formal and informal business intelligence channels. The latter has been discussed in studies that investigate the role of information technology systems and knowledge management for agility development (Dove 1999; Overby *et al.* 2005, 2006; Sambamurthy *et al.* 2003). Change response is based on the way in which an organization responds to external changes in the marketplace (Fayezi *et al.* 2015). Factors that relate to the dimensions of quickness, flexibility and adaptiveness contribute to the change response ability of organizations. Consequently, organizations that adopt a proactive stance with regard to these dimensions are able to reconfigure their resources, up-skill their labour, and develop new products and services in response to changes in their business environment (Lee 2004).

Within the literature, different enablers and drivers that might assist organizations to develop and maintain agility have been identified. Gunasekaran (1998) explains that agile manufacturing enablers are a set of technological (e.g. virtual enterprise and mass customization) and structural (e.g. rapid partnership and re-configurability) tools and techniques that operate throughout the manufacturing organization (e.g. marketing, design and production, and management). Vázquez-Bustelo and Avella (2006) argue that other enablers of agility; human resources, value chain integration, concurrent engineering, advanced technologies and knowledge management have an equally important role to play in agile manufacturing and are becoming increasingly integrated into organizational processes. Zhang (2011) highlights a number of contextual factors that drive agile manufacturing and influence decision-making. These include, for example, business characteristics (including the market and competition), product attributes (e.g. life cycles and maturity stages) and market positioning, which offer important information for cultivating agile capability.

These enablers and drivers contribute to the development of appropriate practices, which are able effectively to nurture organizational agility (Gunasekaran 1998, 1999). The agility practices range from integration and team-building, quality assurance, change and partnership initiatives to education, welfare and technology (Hasan *et al.* 2013; Yusuf *et al.* 1999). Importantly, implementing these practices is contingent upon the effective functioning of agility catalysts: people, process, product, information and structures (Hasan *et al.* 2013; Sharifi and Zhang 1999).

Other areas discussed within the literature centre on agility-related organizational antecedents that can assist companies to improve their performance through efficiency and responsiveness. For example, leadership competency (Asree *et al.* 2010), organizational culture, market orientation (Zelbst *et al.* 2010) and agile values and methods (Ribeiro and Fernandes 2010) are key antecedents for agility in the literature. Researchers have also provided important findings as to how lean capability, in comparison with agile capability, might translate competitive strategies into performance benefits (Hallgren and Olhager 2009). In this context, Narasimhan *et al.*'s (2006) study led them to conclude that, while provision of agility might presume leanness, the reverse does not necessarily hold true, in that being lean may in fact reduce the ability of

Table 4. Organizational and supply chain flexibility articles

No.	Author(s)	Year	Title	Journal	Methodology	Objective(s)
				Organizational flexibility		
1	Buzacott and Shanthikumar	1980	Models for understanding flexible manufacturing systems	AIIE Transactions	Modelling	To review basic features of flexible manufacturing systems and develop models for determining the production capacity of such systems
2	Slack	1983	Flexibility as a manufacturing objective	International Journal of Operations & Production Management	Conceptual	To examine: • The position of flexibility within the set of manufacturing objectives. • What flexibility means in a production context. • How the tasks, decision areas and attributes of a companies' production management influence the various aspects of flexibility. • How the flexibility of manufacturing systems might be measured, or at least assessed in some way.
3	Buzacott and Yao	1986	Flexible manufacturing systems: a review of analytical models	Management Science	Conceptual	To review works on the development of analytical models of Flexible Manufacturing Systems.
4	Gerwin	1987	An agenda for research on the flexibility of manufacturing processes	International Journal of Operations & Production Management	Conceptual	• To demonstrate how it would be possible to develop an operational measure of flexibility. • To provide directions for future research.
5	Upton	1994	The management of manufacturing flexibility	California Management Review	Case study	To present a framework that provides a common language about the various categories of flexibility the company needs to manage.
6	Upton	1995	Flexibility as process mobility: the management of plant capabilities for quick response manufacturing	Journal of Operations Management	Survey	To examine the relationship between one form of manufacturing flexibility – operational mobility (or the ability to change quickly between products) – and structure, infrastructure and managerial policy at the plant level.
7	Sanchez	1995	Strategic flexibility in product competition	Strategic Management Journal	Conceptual	To investigate competition in dynamic product markets from combined resource base and strategic flexibility perspectives.
8	Vokurka and O'Leary-Kelly	2000	A review of empirical research on manufacturing flexibility	Journal of Operations Management	Conceptual	• To synthesize the growing body of empirical research regarding content-related issues and identify possible avenues for future research in the area of manufacturing flexibility. • To examine several important methodological issues regarding manufacturing flexibility research.
9	Narasimhan and Das	2000	An empirical examination of sourcing's role in developing manufacturing flexibilities	International Journal of Production Research	Survey	To examines the role of sourcing practices in achieving manufacturing flexibilities.

10	Giachetti, Martinez, Saenz and Chen	2003	Analysis of the structural measures of flexibility and agility using a measurement theoretical framework	International Journal of Production Economics	Modelling	To demonstrate how application of measurement theory can be applied to define better the structural properties of enterprises and then monitor the enterprise as part of the enterprise strategy.
11	Zhang, Vonderembse and Lim	2003	Manufacturing flexibility: defining and analysing relationships among competence, capability and customer satisfaction	Journal of Operations Management	Survey	• To organize literature on manufacturing flexibility and classify it according to competence and capability theory. • To describe a framework to explore the relationships among flexible competence (machine, labour, material handling and routing flexibilities), flexible capability (volume flexibility and mix flexibility) and customer satisfaction.
12	Koste, Malhotra and Sharma	2004	Measuring dimensions of manufacturing flexibility	Journal of Operations Management	Survey	To address the issue of manufacturing flexibility measurement, and then use these measures to understand flexibility better.
13	Giunipero, Denslow and Eltantawy	2005	Purchasing/supply chain management flexibility: moving to an entrepreneurial skill set	Industrial Marketing Management	Case study	To develop an initial framework for the skills required to attain purchasing and supply management flexibility.
14	Verdú-Jover and Gómez-Gras	2009	Measuring the organizational responsiveness through managerial flexibility	Journal of Organizational Change Management	Survey	• To explore the nature of managerial flexibility and analyse its relationship to the organizational responsiveness of firms. • To measure responsiveness by determining the fit between contextual and organizational variables.
15	Li, Su and Liu	2010	Can strategic flexibility help firms profit from product innovation?	Technovation	Survey	To investigate the moderating effect of strategic flexibility (resource and coordination) on the relationship between product innovation and firm performance.
16	Tamayo-Torres, Ruiz-Moreno and Verdú	2010	The moderating effect of innovative capacity on the relationship between real options and strategic flexibility	Industrial Marketing Management	Survey	To analyse how the use of real options relates to strategic flexibility from a managerial capacity perspective.
17	Patel	2011	Role of manufacturing flexibility in managing duality of formalization and environmental uncertainty in emerging firms	Journal of Operations Management	Survey	To address the following research questions: (a) Is it possible to decouple conflicting structural requirements? (b) How can such dual structural requirements (increased formalization and organic structures) be, in fact, complementary?
18	He, Lai, Sun and Chen	2014	The impact of supplier integration on customer integration and new product performance: the mediating role of manufacturing flexibility under trust theory	International Journal of Production Economics	Survey	To explore the complicated relationships among supplier integration, customer integration and new product performance via the mediating roles of manufacturing flexibility and service capability under the trust theory.

Table 4. Continued

No.	Author(s)	Year	Title	Journal	Methodology	Objective(s)
				Supply chain flexibility		
1	Fawcett, Calantone and Smith	1996	An investigation of the impact of flexibility on global reach and firm performance	Journal of Business Logistics	Survey	To provide relevant insight regarding the creation and the competitive impact of a flexibility-based strategy within an international operating environment.
2	Vickery, Calantone and Dröge	1999	Supply chain flexibility: an empirical study	Journal of Supply Chain Management	Survey	To examine dimensions of supply chain flexibility and their relationships with environmental uncertainty, business performance and functional interfaces.
3	Narasimhan and Das	1999	Manufacturing agility and supply chain management practices	APICS Production & Inventory Management Journal	Conceptual	To study the role of supply chain management in developing operational flexibilities to support agile manufacturing in a firm.
4	Golden and Powell	1999	Exploring inter-organizational systems and flexibility in Ireland: a case of two value chains	International Journal of Agile Management Systems	Case study	To explore the use of inter-organizational systems and the impact they have on flexibility.
5	Golden and Powell	2000	Towards a definition of flexibility: in search of the Holy Grail?	Omega: the International Journal of Management Science	Conceptual	To propose a definition and metrics of flexibility that can be used to measure a specific type of information technology (inter-organizational systems).
6	Zhang, Vonderembse and Lim	2002	Value chain flexibility: a dichotomy of competence and capability	International Journal of Production Research	Conceptual	To explore the relationships among environmental uncertainty, value chain flexibility and competitive advantage.
7	Duclos, Vokurka and Lummus	2003	A conceptual model of supply chain flexibility	Industrial Management & Data Systems	Conceptual	To examine flexibility classification schemes and the commonalities of flexibility typologies published in the literature to create a theoretical foundation for analysing the components of supply chain flexibility.
8	Das and Abdel-Malek	2003	Modelling the flexibility of order quantities and lead-times in supply chains	International Journal of Production Economics	Modelling	To introduce a measure for estimating supply chain flexibility as a function of varying order quantities and varying supply lead-times.
9	Young, Sapienza and Baumer	2003	The influence of flexibility in buyer-seller relationships on the productivity of knowledge	Journal of Business Research	Survey	To examine the knowledge substitution and flexibility effects derived from the relational and resource-based views of the firm.
10	Sánchez and Pérez	2005	Supply chain flexibility and firm performance: a conceptual model and empirical study in the automotive industry	International Journal of Operations & Production Management	Survey	To explore the relationship between the dimensions of supply chain flexibility and firm performance in a sample of automotive suppliers.
11	Lummus, Vokurka and Duclos	2005	Delphi study on supply chain flexibility	International Journal of Production Research	Case study	To explores the characteristics of flexible supply chains by conducting a Delphi study.
12	Avittathur and Swamidass	2007	Matching plant flexibility and supplier flexibility: lessons from small suppliers of US manufacturing plants in India	Journal of Operations Management	Survey	To investigate the effect on the buyer's performance when buyer and supplier flexibilities are matched.

13	Stevenson and Spring	2007	Flexibility from a supply chain perspective: definition and review	International Journal of Operations & Production Management	Conceptual	To further our understanding of supply chain flexibility and provide a comprehensive review of the available literature.
14	More and Subash Babu	2008	Perspectives, practices and future of supply chain flexibility	International Journal of Business Excellence	Conceptual	• To present a consolidated account of various views expressed by academicians and practitioners by bringing to the fore, various research options available in the area of supply chain flexibility. • To addresses the relevance of various forces and the role of dynamics in managing supply chain flexibility.
15	Phillips and Wright	2009	E-business's impact on organizational flexibility	Journal of Business Research	Case study + Survey	• To highlight some of the strategies required to enhance flexibility in an e-business environment. • To explore how flexibility affects organizational effectiveness, and to identify factors effecting success in an e-business environment.
16	Van der Rhee, Verma and Plaschka	2009	Understanding trade-offs in the supplier selection process: the role of flexibility, delivery, and value-added services/support	International Journal of Production Economics	Survey	To answer the following questions: • How do managers trade-off between price and other competitive dimensions when choosing a supplier for commodity raw materials, given the acceptable quality? • What is the relative importance of value-added service and support when choosing a supplier for commodity raw materials, given the acceptable quality? • How do trade-offs in the supplier selection process differ across cultural/national regions?
17	Blome, Schoenherr and Eckstein	2014	The impact of knowledge transfer and complexity on supply chain flexibility: a knowledge-based view	International Journal of Production Economics	Survey	• To investigate the influence of internal and external knowledge transfer activities on supply chain flexibility. • To hypothesize the moderating effects of product and supply complexity on the relationships between knowledge transfer and supply chain flexibility.

Total: 35 articles

an organization to remain agile because of issues associated with access to resources and their depletion (Fayezi *et al.* 2012). Importantly, evidence suggests that the building and nurturing of these antecedents ensures that an organization is capable of responding to marketplace uncertainties and changes in an effective and timely way (Fayezi *et al.* 2015).

Ribeiro and Fernandes (2010) and Bessant *et al.* (2002) have examined small and medium enterprises (SMEs) in an attempt to understand the factors that assist SMEs to achieve higher levels of agility. In this regard, Ribeiro and Fernandes (2010) identified the beneficial role of workplace interactions, working software, customer collaboration and responding to change within construction SMEs. There are also country-specific studies: for example, Vázquez-Bustelo *et al.* (2007) and Vázquez-Bustelo and Avella (2006) worked on the agile capabilities of Spanish manufacturing firms. These investigations resulted in development and testing of an agile manufacturing model that illustrates how agility affects the manufacturing strength of a company. The country-specific studies have also been used by researchers to gain further insights into cultural attributes and drivers, in order to understand whether there are any areas of convergence and divergence associated with development of organizational agility. A principal outcome from these studies is that effective development of agility relates to the size of an organization and its geographical and cultural orientation.

To summarize, the literature surrounding organizational agility highlights that it is important for companies to align their change expectancy and response mechanisms with various organizational characteristics (e.g. industry, company size, geographical location) as well as operating environments (e.g. product type: functional or innovative) (Fisher 1997; Lee 2002). An agile organization must be able to convert changes quickly into opportunities (Sharifi and Zhang 1999; Zhang 2011). Organizational agility, while important and necessary, needs to be leveraged and maintained across the supply chain to create sustainable success for a business (Fayezi *et al.* 2015).

Supply chain agility

The supply chain provides a better and more transparent platform for assessing and understanding agility, as opposed to a single organization where some of the processes are rendered invisible because of competitive priorities. The supply chain also highlights various complexities (e.g. network efficiencies) that are involved in developing and maintaining agility among multiple organizational interests (van Hoek *et al.* 2001). The literature argues that supply chain agility can influence an organization's success and prosperity (Baramichai *et al.* 2007; Mathiyalakan 2006; Qrunfleh and Tarafdar 2013; Swafford *et al.* 2006). For example, information technology integration and flexibility in an organization's internal functions have been shown to act as the precursors of supply chain agility through increased processing and operational management efficiencies (Swafford *et al.* 2006, 2008). Similarly, internal (cross-functional operations) and external (with suppliers and customers) integration are influential in establishing an organization's ability to act in an agile manner within its own supply chains (Braunscheidel and Suresh 2009). These studies emphasize the need for a stronger reliance on intra-organizational capabilities (e.g. information technology infrastructure, functional flexibility and cross-functional collaboration) to maintain and develop inter-organizational agility.

While a number of studies emphasize that an organization's relationship with its partners is the cornerstone to effective supply chain management, this has proved to be problematic for some organizations in terms of time and cost (Barratt 2004; Christopher 2005; Danese 2011; Ellram and Cooper 2014; Lambert *et al.* 1996). This highlights the importance of relationship dynamics to supply chain agility (Kisperska-Moron and Swierczek 2009; Ngai *et al.* 2011). However, within the literature (see, for example, Squire *et al.* 2009; Swafford *et al.* 2006) much of the focus centres on process integration (material and financial flows), rather than actual relationship integration (relationship and information flows). This is in spite of the fact that effective relationships can enable processes to be successfully executed both within and between the organization and the supply chain (Brindley and Ritchie 2004). A consequence of the lack of focus on relationship factors – trust, information sharing, commitment, communication, risk and reward sharing – and how they influence the development and maintenance of agility within supply chains is poor supply chain integration (O'Loughlin and Clements 2007). This does not necessarily mean that an extensive allocation of costly resources is required to build and manage relationships, but rather suggests that organizations need to be more responsive and strategic with regard to the required level of relationship integration. Essentially, an important gap in the agility literature centres on the fact that a relationship-oriented research focus has

yet to be fully developed and explored (Fayezi *et al.* 2015).

A number of studies argue that relationship structures, with key input suppliers, are invaluable for improving the responsiveness of supply chains (Handfield and Bechtel 2002; Kisperska-Moron and Swierczek 2009). More importantly, it has been widely reported that organizations that develop a highly evolved understanding of trust are more likely to reduce the negative effects of power–dependence imbalance in some buyer–supplier relationships (Handfield and Bechtel 2002). Extending this, asset-specific commitment by suppliers has been shown to act as a primary building block of trust in relationships (Handfield and Bechtel 2002). Similar findings have been presented with regard to relationship integration and collaboration, which substantially embraces agility maintenance and development across the supply chain (e.g. Kisperska-Moron and Swierczek 2009; Squire *et al.* 2009; Yusuf *et al.* 2004). What is important to note here is that the strength of both inbound and outbound supply chain linkages are crucial to relationship development (Braunscheidel and Suresh 2009; Kisperska-Moron and Swierczek 2009). It is acknowledged within the literature that highly agile organizations are capable of leveraging their suppliers' abilities for greater customer satisfaction (Power *et al.* 2001). Conversely, less agile organizations are internally focused (in terms of operational capacity) and are mostly concerned with managing their technological enablers (Power *et al.* 2001). Critically, however, these studies provide little or no information concerning how these relationship factors might benefit companies with respect to managing organizational responsiveness, as described by Gligor and Holcomb (2012a).

The literature that investigates supply chain agility also concentrates on the role that a partner's (supplier or customers) characteristics play in relationship development. This is in spite of the evidence that shows within network environments that the actions and behaviours of key (and even minor) actors has important repercussions for the supply chain as a whole (Cheng and Kam 2008) and its ability to respond to change (Gligor and Holcomb 2012a). Squire *et al.* (2009) have addressed the issue of partners' characteristics and their implications for supply chain management by incorporating suppliers' manufacturing capabilities and investigating their effect on buyer responsiveness. Flexibility, responsiveness and modularity were described as the suppliers' manufacturing capabilities, all of which were found positively to influence buyer responsiveness (Squire *et al.* 2009). This finding serves to emphasize the significance of partner diversity in terms of their capabilities and characteristics, as well as the difficulty in maintaining agility within complex supply chain environments. Hoyt *et al.* (2007) posit that it is the criticality of supplier selection (and their capability characteristics) within an agile system that affects supplier responsiveness. Consequently, there is a need for future research to investigate partners' specific characteristics in relation to supply chain agility development. In this regard, the literature investigating supply chain risk (see, for example, Hallikas *et al.* 2005; Sinha *et al.* 2004; Trkman and McCormack 2009; Zsidisin 2003; Zsidisin *et al.* 2004) provides useful insights into the risks associated with supply chain partner characteristics and capabilities to enhance organizational responsiveness.

Therefore, it can be argued that organizational relationships are crucial for understanding supply chain agility. However, it should be acknowledged that elements common to an organization (e.g. cooperation and quickness) do not exist in the same way in supply chains. This is partly due to supply chains existing in what appears to be moderately anarchic states, where regulatory control is bounded, and complete oversight of the supply chain is constrained by competitive positioning (O'Loughlin and Clements 2007). Consequently, any attempt to apply dimensions of organizational agility to the supply chain needs to be considered carefully because of their different dynamics (Fayezi *et al.* 2012).

The literature has focused mostly on exploiting various partner- and relationship-specific factors, which are used/manipulated to create greater supply chain agility. Baramichai *et al.*'s (2007) work highlights the importance of relationship development, and perceives agile supply chains as composed of multiple long-term coordinated relationships with corresponding agile partners. Christopher (2000) sees supply chain agility as being composed of a network-wide concept that is characterized by highly competitive tendencies where sensitivity to market, existence of virtual organizations, process integration and network integration are the key determinants of relationship integration. Kisperska-Moron and Swierczek (2009, p. 218) argue that, as economies have changed and trading dependencies have increased '[t]he idea of an agile supply chain as a confederation of partners linked together as a network[,] provides the crucial ingredient of agility', and these alliances make sense in environments which are highly unstable. Owing to

the parsimonious nature of much of the research, the supply chain is presented as a flawless, balanced and synchronized alliance. There is a persistent failure to recognize that alliances are much more complex, and coalescence is tempered by, for example, self-interest and how much value a relationship adds. Accordingly, to maximize supply chain agility, organizations need carefully to manage the relationships that are legally separate, but operationally interdependent (i.e. suppliers, customers, manufacturers) and understand the imperfect nature of supply chain interactions (Lin *et al.* 2006; Ngai *et al.* 2011; Yusuf *et al.* 2004).

There is strong agreement among researchers concerning the components of supply chain agility (specifically the aspects of sensitivity, response ability, quickness, collaboration, systems and processes), yet there is no widely agreed or accepted view as to how these components combine to create an agile supply chain. Table 3 illustrates the problem, in that, while the elements contained within the table can be considered to be the principal source of supply chain agility, caution is required when making generalizations concerning supply chain dynamics and, in particular, the influence that participating organizations might have on theirs and other supply chain networks. Recent studies on, for example, network (Chen and Chiang 2011) and customer (Roberts and Grover 2012) agility provide a useful insight into the complexities surrounding supply chains and, in doing so, highlight a number of important constraints that organizations face within supply chains and, in particular, why there may be finite limits restricting the ability of an organization directly to influence supply chain agility.

Organizational and supply chain flexibility

This section provides an overview of the organizational and supply chain flexibility literature (see Table 4). Organizational flexibility has been included so as to review the influence that this stream of the literature has on supply chain flexibility understanding and development.

Organizational flexibility

The concept of flexibility operating at the level of organization is relatively well understood within the literature. This can be attributed partly to the attention that flexibility, as a topic has received from researchers since the early 1980s (Giachetti *et al.* 2003). Flexibility is a key precursor to an agile organization (Sharifi and Zhang 1999). Conceptually, organizational flexibility can locate its origins within the manufacturing research literature, where a strong technology-driven focus encouraged researchers to investigate how flexibility might translate into the other organizational functions, particularly in operations and supply chain (Buzacott and Shanthikumar 1980; Buzacott and Yao 1986).

The operational development of flexibility has concentrated on the key dimensions, types, antecedents, mechanisms and consequences. In relation to its dimensions, time and cost are central to developing flexibility in organizations. Slack (1983) maintains that managing time and cost is vital to making changes to an organization's systems, structures and processes, and that time slippage, almost more than anything else, can have a deleterious effect on an organization's ability to compete. Upton (1994) extends this argument and suggests that time and cost drivers are key to operational mobility within a flexible organization. Upton (1994) further suggests that it is the availability of competitive options that ultimately determines organizational flexibility. This is known as 'range' in the literature (Upton 1994). Koste *et al.* (2004) subdivided range factors into range-numbers and range-heterogeneity, which refer to the quantity and dissimilarity of the options available to the organization. Range-heterogeneity adheres to a common set of principles, which regulate the ability of an organization to manage its time, cost and range structures in response to internal and external uncertainties.

The differing categories of flexibility that are found within organizations are characterized by the different classes of variables used in the research: machinery, labour, delivery, volume, mix and market (Vokurka and O'Leary-Kelly 2000). Importantly, one of the key areas of organizational flexibility that has garnered considerable attention in the literature is an organization's response to uncertainty. Gerwin (1987) was one of the first researchers to make an association between the different types of uncertainty with the various modes of flexible response within organizations. By way of an example, product-mix flexibility is portrayed in the literature as an organizational coping mechanism, particularly where there is a high level of, or considerable uncertainty relating to, market and customer product acceptance.

Within the literature, a number of antecedents for maintaining and developing flexibility are discussed. Tamayo-Torres *et al.* (2010) have argued that, by

operationalizing strategic flexibility, organizations are able to update strategies and approaches in response to external change. 'Operative real options' are defined as the management's ability to make positive changes in management operations, while 'strategic real options' denote latent opportunities in an investment (Tamayo-Torres *et al.* 2010). It is important to note here that, while researchers recognize that managing operational and strategic change is necessary, it is of and by itself insufficient in order to foster flexibility (Tamayo-Torres *et al.* 2010). The argument presented in the literature is that organizations need to cultivate an innovative capacity to enjoy higher flexibility, which originates from their operational and strategic capabilities (Tamayo-Torres *et al.* 2010). In an attempt to overcome problems associated with increasing innovative capacity, researchers of organizational flexibility identified additional antecedents for flexibility maintenance and development: efficiency through enhanced sourcing practices (Narasimhan and Das 2000); management of operational competencies (Zhang *et al.* 2002); staff development (Giunipero *et al.* 2005); and improvements in the application of technology (Vokurka and O'Leary-Kelly 2000). These are important because managers need to consider the internal environment in which flexibility takes place, and then be able to map this to the wider external strategic interests of the organization.

The literature also explains the management mechanisms that underpin flexibility; for example, Sanchez (1995) explains resource and coordination flexibilities in an organization in terms of strategic flexibility, while Verdú-Jover and Gómez-Gras (2009) highlight different layers of flexibility in organizations (e.g. strategic, structural and operational flexibilities) under the broader heading of managerial flexibility, emphasizing the role that managers play in this process. Li *et al.* (2010) have extended this to show that strategic flexibility has a moderating effect on the performance of innovative organizations. From a structural perspective, there is a strong argument in the literature for integrating both flexible and rigid structures into the operational processes of organizations in order to maintain lower costs and increase performance (Patel 2011; van der Rhee *et al.* 2009). The principal theme within these studies is that flexibility is a complex, multidimensional process that organizations need to manage across their various functional layers in order to maximize its impact with regard to operational and strategic efficiencies.

Extending this further within the literature, the exploration of the performance effect of flexibility on organizations is another key area of interest. The link between flexibility and performance has been discussed under a variety of topics; including uncertainty, flexible capabilities, structural duality and product innovation (Fayezi *et al.* 2015). It is suggested that flexibility is a pliable concept that can be managed through the adoption of different strategies. There is also a strong correlation with the adoption of contingency measures, in which contextual factors are deemed critical for the organization to engineer its response to uncertainty/change in both the internal and external environment (Danese 2011). Organizational responsiveness is something that companies acquire through the adoption of flexible structures and operations. However, flexibility in and of itself is not a solution, but a means by which a company can deliver a specific response (Verdú-Jover and Gómez-Gras 2009). For example, He *et al.* (2014) provided empirical evidence illustrating this relationship by showing that the internal deployment of manufacturing flexibility is able to influence customer assimilation by strengthening the competence base and increasing trust (Sako 1992) between the manufacturer and the customer. A consequence of this is that it has been variously argued that greater customer integration is the key to enhancing new product development performance and also improving time to market (He *et al.* 2014).

Within the literature on organizational flexibility it is evident that there is a greater concentration on a limited number of key research areas, particularly regarding the dimensions, types, antecedents, mechanisms and consequences and their relationship with/to an organization's operational and strategic processes (e.g. automation, routing, design and structure, innovation). However, the importance of, and the role that relational and behavioural systems play in, guiding the implementation of flexibility has been overlooked. The existing literature has concentrated on processes rather than employee, customer and supplier characteristics. This gap in relationship and behavioural systems research is a major weakness within both the academic literature and our comprehension. The role and influence that individual actors and groups have in the implementation of flexibility is marginalized, in part through heavily reductionist research strategies, but also because they act as a direct challenge to the role of the organization as the dominant contributor and manager of flexible processes. Addressing this limitation is important, as it highlights a significant

mismatch in the importance and role of individuals and organizations within supply chains.

Supply chain flexibility

Supply chain flexibility is a rapidly evolving area of research, with multiple perspectives, conceptualizations and measurements (More and Subash Babu 2008; Stevenson and Spring 2007). Importantly, supply chain flexibility has been heavily influenced by the literature surrounding organizational flexibility. A number of researchers have improved academic and practitioner understanding regarding the central tenets of supply chain flexibility. The work of Fawcett *et al.* (1996), Golden and Powell (1999), Narasimhan and Das (1999), Vickery *et al.* (1999) and Zhang *et al.* (2002) are important in this regard. Significantly, each of these papers has repositioned flexibility from that of an *intra*-organizational concept, to one that encapsulates *inter*-organizational dynamics and relationships.

Fawcett *et al.* (1996) argue that maximizing organizational performance can be achieved only when flexibility is included as a cross-functional management priority. Consequently, Fawcett *et al.* (1996) have integrated manufacturing and logistics flexibilities into their theoretical model that seeks to explain the impact of flexibility on global reach and firm performance. Vickery *et al.* (1999, p. 16) has extended Fawcett *et al.*'s (1996) work and included product, volume, launch, access and target market responsiveness in the supply chain flexibility definition, considering the latter factors as 'shared responsibility of two or more functions along the supply chain'. Zhang *et al.*'s (2002) work is perhaps the most expansive and pervasive, as they conceptualized flexibility as existing along the entire value chain and being composed of product development, manufacturing, logistics and a variety of additional integrative activities. While these studies have investigated the link between supply chain flexibility and organizational performance, Narasimhan and Das (1999) and Golden and Powell (2000) have concentrated their research on the effect of supply chain management practices (e.g. early supplier involvement in product design) and inter-organizational systems (e.g. electronic data interchange), and whether flexibility might be the result of specific relationship and behavioural engagement. All these papers have been instrumental in transforming the traditional view on supply chain to one that considers it as a network of influential actors.

Supply chain researchers have long recognized the importance of inter-organizational systems and relationships, as well as the role that partner flexibility plays in terms of developing and maintaining flexibility within the supply chain (Golden and Powell 1999; Phillips and Wright 2009; Young *et al.* 2003). Sánchez and Pérez (2005) have identified an important practical tension that exists between efficiency and cost, and go on to explain that organizational interest in flexible practices starts to decline substantially beyond shop floor implementation. The authors contend that this is because flexibility is seen as an operational process. To support this observation and using data from the Spanish automotive sector, Sánchez and Pérez (2005) concluded that a myopic view, centred on shop floor flexibilities, prevents companies from expanding the accrued benefits to include customer–supplier flexible capabilities. Van der Rhee *et al.*'s (2009) research suggests that this myopia is possibly due to important cultural determinants, which influence how flexible practices are developed. Van der Rhee *et al.*'s (2009) study found that the introduction of flexible practices is a priority for German, French, Italian and British companies, particularly with regard to supplier selection processes, and also how they engage with their customers.

However, problems do persist and, as yet, no comprehensive research has been undertaken to examine why organizations that are considered highly flexible within their own internal operations are unable to emulate this within their supply chains (Avittathur and Swamidass 2007). Duclos *et al.* (2003), Lummus *et al.* (2005) and Stevenson and Spring (2007) offer some insight into to why this might occur when they argue that supply chain flexibility can be broadly understood as an integration of intra- and inter-organizational flexibilities and the organization's own relationships. The problem for many companies is that integration requires that organizations develop consensual and trusting relationships, and the principal locus of power and control can fall outside management's areas of influence and authority. Stevenson and Spring (2007) highlight additional problems relating to integration through the multidimensional nature of supply chain flexibility, and emphasize the following attributes as key drivers in the integration process: robust network flexibility; re-configuration flexibility; active flexibility; potential flexibility; and network alignment. Lummus *et al.* (2005) have tried to address these weaknesses through their model of supply chain flexibility by examining the characteristics that contribute to the flexibility of a supply chain:

operations systems; logistics processes; supply network; organizational design; information systems; customer satisfaction; and supply chain assets. These characteristics underline the contribution of hard and soft business processes to the provision of flexibility in the supply chain. However, as the complexity of the supply chain increases, being able to maintain control over certain aspects of the process becomes increasingly problematic as the power base shifts (Blome *et al.* 2014). The authors argue that these problems and complexities could be better managed through an effective and responsive relationship management programme that engages all the different parties and looks to maximize any and all efficiencies.

The interactive aspects of network relationships and their impact on supply chain flexibility have been researched only to a very limited degree, and this remains an important and evolving area of study. The available literature suggests that, where zones of tolerance (Wilson 2006) and relationship elasticity (Das and Abdel-Malek 2003; Zomorrodi and Fayezi 2011) dominate supply chain relationship development, abnormal behaviours are less likely to occur. This is most apparent when, for example, relationship flexibility reduces perceived cognitive and physical distance (through information sharing) and diversity (channels/types of information sharing) when communicating order changes (Zomorrodi and Fayezi 2011).

Gap analysis

An analysis of the agility and flexibility literature has revealed a number of important gaps in academic understanding of how these concepts have evolved, been developed and subsequently implemented. The following section points the way forward with regard to how these gaps might be addressed. As outlined earlier, the gaps fall into three specific categories: conceptual, contextual and methodological, as outlined below.

Conceptual gaps

The literature addresses the problem of conceptual differences between agility and flexibility in broad and overlapping terms. Baker (1996) focused on the 'level of application' as the distinction between agility and flexibility. This argument relates to the decision hierarchy of an organization, in which agility operates at the strategic level and flexibility is an operational process. Baker (1996) further argues that range and response (time/cost) are critical, and that agility entails both range and response, while flexibility might involve either one or the other, but not both (Bernardes and Hanna 2009; Charles *et al.* 2010; Christopher 2000; Wadhawa and Rao 2003).

The conceptual gaps within the literature either perceive agility as composed of a number of core elements centring on flexibility (Prater *et al.* 2001; Sharifi and Zhang 1999; Vernadat 1999) or as an extension of flexibility (Backhouse and Burns 1999; Richter *et al.* 2010; Tan 1998; Vokurka and Fliedner 1998). The authors' review of the literature has identified a number of important similarities and differences relating to the existing views of academics towards agility and flexibility. Considering these similarities and differences assists in better understanding and development of agility and flexibility by attending to the focus and function of agility and flexibility in supply chains.

The literature indicates that a vision of sustained enterprise success through well-aligned change expectancy and change response mechanisms drives agility. This is apparent in, for example, the dimensions and antecedents that are discussed in the organizational and supply chain agility literature, which highlight the importance of strategic pre-emption with regard to developing agility (e.g. proactiveness, responsiveness, virtual enterprise, design, intelligence and mindset). When considering flexibility, the literature is divided into operational interests and organizational functions. The operational aspects are evident in the researchers' focus on time, cost and range as key dimensions of flexibility, which represent an orientation towards operational responses to changes taking place both internally as well as external to the organization. The organizational functions of flexibility are conceptualized as, for example, procurement, manufacturing, distribution and information systems. Academics regard flexibility as a response lever that companies use to manage uncertainties and changes in both internal and external environments.

Importantly, agility is strategic in focus and involves the rapid sensing of, and response to, external stimuli, while flexibility emphasizes internal process-driven operational change competencies. As a consequence, the authors assert that, by undertaking a detailed comparative analysis of how agility and flexibility might manifest themselves within supply chains, this will assist academics in recognizing how terminology has been applied

regarding focus (strategic–operational) and function (paradigm–process), and how these terms have been used to explain uncertainty within organizations and also corresponding supply chains.

Contextual gaps

A review of the literature on supply chain agility and flexibility highlights the lack of attention given to relationship dynamics. The organizational literature has greatly influenced academic understanding of relationship development and maintenance. While acknowledging its importance, this has effectively diverted both attention and research away from the management of supply chain relationships, and the role that agility and flexibility play in maintaining competitive advantage. For example, much of the research has focused on identifying and separating the control structures within the organization, as opposed to managing power and relationship configurations within the supply chain. While organizations have boundaries with a set of legal, relational and cultural norms and procedures that constantly engage with the organization's control systems, outside contractual obligations no governing framework exists to administer the entire range of supply chain relationships and behaviours. Supply chain partners might have similar goals that motivate their actions; however, behavioural (self-interest), political (power transition, sanctions) or financial (shorter credit terms) tensions pervade these relationships and, as a consequence, supply chain partners will attempt to vary the rules of engagement in order to maximize their own control.

Only a small number of studies have explored the dynamics that underpin supply chain relationships in relation to supply chain agility and flexibility (see, for example, Kisperska-Moron and Swierczek 2009; Yusuf *et al.* 2004). This leads us to the assertion that a detailed analysis of agility and flexibility within supply chains will assist academics to recognize how relationship integration (in terms of the convergence or divergence of the following factors: trust, information sharing, commitment, communication and risk/reward sharing) significantly alters the way in which organizations both respond to and engage with one another in order to mitigate uncertainty across the supply chain.

Methodological gaps

A review of methodological designs within the literature reveals a variety of preferences. In Table 5, the majority of the research is empirical – it is based on surveys and/or case studies (31 out of 49 [agility], 22 out of 36 [flexibility]). Areas where there are gaps include case study analysis (9 out of 49 [agility], 5 out of 36 [flexibility]) and modelling (4 out of 49 [agility], 3 out of 36 [flexibility]) methodology designs. It is important to note that case studies are focused on the manufacturing sector and concentrated on the well-known organizations (see Tables 2 and 4).

Table 5. Methodology designs[a]

Design	Survey	Case study	Modelling	Conceptual
(a) Methodology designs in the agility literature[b]				
Frequency	22	9	4	14
(b) Methodology designs in the flexibility literature[c]				
Frequency	17	5	3	11

Notes:
[a] *The methodology design classification is adapted from Seuring et al.* 2005
[b] *The total number of agility-related articles based on their methodology design is 49.*
[c] *The total number of flexibility-related articles based on their methodology design is 36.*

Case study designs are useful, as they help researchers to understand the importance and pervasiveness of the conceptual and contextual gaps within the supply chain. Case studies provide the opportunity to collect rich data, while also taking into account various contingencies and specificities associated with different supply chain dynamics (Näslund 2002). Modelling, in contrast, enables scenario development and the assessment of various supply chain agility and flexibility activities that are difficult to categorize using other research methods. Mixed-methods designs also offer a potential solution for researchers when trying to understand the variables that underpin supply chain uncertainty (Golicic and Davis 2012). This gives rise to our final assertion that the use of case studies and modelling methods are an essential component for understanding the development of agility and flexibility and their influence on an organization's operational and strategic direction. This will also assist researchers in clarifying the role that relationship integration has in supply chain uncertainty, and the response mechanisms associated with the agility and flexibility of supply chain members.

Conclusions, contributions and implications for theory and practice

This paper has focused on answering the following question: How can agility and flexibility be better

understood and developed within supply chains? In doing so, it has addressed a number of arguments concerning the positioning of agility and flexibility within the supply chain management literature. The paper has also sought to provide context, as well as highlight areas where further research is required. More importantly, particular concern was raised that much of the research relating to agility and flexibility within the supply chain has been conducted using terminology based on descriptions that are closely associated with organizational agility and flexibility as definitional and practical surrogates. This is a highly contentious issue, as there is an automatic assumption within the literature that the internal dynamics of the organization are a reflection of those found within the supply chain. The evidence clearly shows this is not an accurate representation because, for example, control, trust, information sharing and commitment all require extensive development and, more importantly, the careful management of external relationships in order to operate efficiently.

The research for this paper was performed via a structured review of 83 peer-reviewed articles. The literature review presented here is different from the previous studies in terms of its aim, scope, approach, popularity, methodology and contribution. The review covers major academic publications, which investigate how agility and flexibility has been researched and developed.

Theoretically, the review contrasted the gaps that exist at the conceptual (areas of difference; agility and flexibility), contextual (unit of analysis; organizational and supply chain) and methodological levels (choice of methods; case study and modelling). In relation to the conceptual gaps, the paper's contribution here centres on synthesizing the notions of agility and flexibility and identifying their conceptual structure and domain. It is argued that a better conceptual understanding of supply chain agility and flexibility requires a thorough examination of the specific dimensions and antecedents giving rise to these phenomena, importantly recognizing the difference between agility and flexibility in terms of their focus (strategic and operational) and function (paradigm and process) within the supply chain. The review has revealed that the organizational literature is an important resource in this regard, as it provides an extensive, rich and useful dialogue concerning the conceptual framework that underpins agility and flexibility.

With regard to the contextual gaps, considerable attention has been given to organizational understanding of agility and flexibility in comparison with the supply chain interpretations of the same phenomenon. The paper's key contribution involves illustrating the importance of relationship management as a foundation for developing agile and flexible capabilities within supply chains. This is an important finding, as the review clearly highlights that there is a paucity of literature addressing relationship development and management within supply chains.

In addressing the methodological gaps, the paper contributed by providing an overview of the different research methods employed by researchers involved with supply chain agility and flexibility. A primary observation is that much of the research has concentrated on empirical studies that emphasize either a purely statistical analysis of key phenomenon or some of the behavioural dimensions. The concern is that both approaches are overly reductionist and ignore some of the refinements that a modelling or a mixed-methods study would provide. This is not to undermine or decry what has already been done, but single-method studies are overly parsimonious and, therefore, miss some of the more important practical behaviours and their subsequent impact on supply chain operations, relationship development and strategic manoeuvring and control. The authors argue that a more balanced approach to the choice of research method is important to the development of the subject area and the discipline as a whole.

The paper has provided an in-depth analysis of the dimensions of agility and flexibility and offered evidence from the literature that agility is conceived of as a 'macro' externally directed response, while flexibility concentrates on the 'micro' elements concerning organizational operations. As such, agility is considered, within the literature, to be a paradigm for change with regard to supply chain management (Tseng and Lin 2011; Vinodh 2010) that constantly promotes proactiveness, responsiveness, information system/technology, quickness, adaptiveness, flexibility and cooperation both within and between supply chain participants. Contrasting this, flexibility is held to be an internal process response triggered by stimuli (not constantly in operation). This explains why the concepts are used interchangeably, and it has to be said incorrectly by academics and practitioners alike (Fayezi *et al.* 2015). Is the definitional misapplication important? The answer is an emphatic 'yes', as the organization's subsequent reaction is determined by the origin and source of the driver of change (internal or external) and the strategic response required by management at the operational level. Getting the response wrong impinges on the ability of organizations

to remain competitive and can send the wrong signals to other supply chain participants (O'Loughlin and Clements 2007).

Extending the above, and of significant importance, is recognition by this paper of the problems that arise with regard to the contextual gap, specifically, the loss of management control as organizations move from 'intra' to 'inter' levels within the supply chain. The principal problem centres on an increase in the communication layers and the degree of difficulty in effectively managing relationships externally. In a bilateral relationship there is the possibility of greater level of control in achieving higher levels of agility and flexibility by effectively managing individual relationships as well as the relevant processes and structures. In this regard, strong regulatory frameworks and effective contract mechanisms are important to obtain desired actions and behaviours from partner organizations. This serves as a reminder that the complexities surrounding the successful implementation of agility and flexibility within the supply chain are frequently associated with poor relationship integration, where both practical and philosophical differences are difficult to manage and overcome (O'Loughlin and Clements 2007). In addition, higher-level external environmental factors (e.g. political, social, economic and cultural), if not managed correctly, may in turn lead to increased relationship tension between the partners, causing supply chain effectiveness to deteriorate and trust to erode.

In practical terms, the paper serves to demonstrate that a sound understanding of agility and flexibility across the supply chain requires an integrative approach, which also prioritizes relationship integration. Evidence from a number of studies suggests that managers' relationships are biased towards, as well determined by the geographical proximity of many suppliers (Christopher *et al.* 2004; Patti 2006), particularly when looking to improve supply chain flexibility or the size of the suppliers/supply base. Importantly, the review of the literature presented in this paper provides a more detailed explanation of how agility and flexibility respond within different supply chain settings (e.g. issue, industry and country). The paper has also provided evidence to show how supply chain relationship integration can positively inform decision-making regarding initiatives and programmes that target supplier and customer comprehension of the supply chain and, most importantly, how agility and flexibility provide a stronger and more competitive platform during periods of extreme uncertainty.

Additionally, this paper serves to remind researchers of some of the issues relating to supply chain myopia (O'Loughlin and Clements 2007) and how, by ignoring organizational and supply chain relationships, trust, commitment and information sharing, it is possible to undermine business responsiveness by oversimplifying decision-making. The authors therefore recommend that managers look to build stronger and fully integrated relationship networks with both customers and suppliers, so as to alleviate tensions caused by having to manage multiple touch points, affiliations and connections within the supply chain.

Limitations and future research

The paper, while contributing to a better understanding of agility and flexibility in supply chains, is subject to a number of limitations. The authors recognize that the paper's focus on relationship dynamics is narrow and does not consider all the parameters (e.g. process and technology integration, legal frameworks, institutional drivers) or conditions important to the development of supply chain agility and flexibility development programmes. Therefore, future research needs to expand on what has been presented here and investigate the dimensions, antecedents and consequences that are important for organizations, managers and supply chain partners in terms of how agility and flexibility are developed, sustained and ultimately managed. Extending this further, research also needs to be undertaken to examine key motivators and inhibitors of supply chain agility and flexibility within different sectors and also geographical settings. This will provide academics with a better understanding of the financial, social and cultural costs, effectiveness and impact of maintaining agile and flexible supply chain relationships, as well as the processes needed and technologies employed. Another important limitation centres on the lack of attention given to differences in suppliers' and customers' levels of agility and flexibility, and how this ultimately affects relationship outcomes. Finally, future research must recognize and consider the differences between the concepts of agility and flexibility in terms of their focus, function and impact of relationship integration when operationalizing and/or applying them. In this regard, use of case study, modelling and mixed-methods designs can contribute to the expansion of the existing knowledge base on agile and flexible supply chains.

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