

SUPPLY CHAIN KNOWLEDGE MANAGEMENT: A CONCEPTUAL FRAMEWORK

Adrian Done

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Abstract

The supply chain literature still largely focuses on asset, alphanumeric data and information (in the form of documents and files) elements of exchange between supply chain partners, despite the fact that increased integration and collaboration clearly require development of more complex elements of expertise and knowledge. In this respect, this paper recognizes the knowledge management (KM) literature as a potential source of new insights to add conceptual depth and understanding to managing 21st century supply chains. Specific KM theories and constructs are identified as potentially contributing to theory and practice in supply chain contexts. An overall framework for supply chain knowledge management is developed along with literature-based definitions of supply chain knowledge transfer, competence and maturity constructs. The “knowledge lens” theory building approach is applied to import these perspectives into supply chain domains, with efforts to maintain conceptual consistency across the two literature streams.

Keywords: Knowledge Management, Supply Chains, Conceptual Framework

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SUPPLY CHAIN KNOWLEDGE MANAGEMENT: A CONCEPTUAL FRAMEWORK

Introduction

Supply chain management is an important area of research. In light of the managerial challenges of coordinating the supply chain, the subject has received considerable attention from multidisciplinary academic communities over the last two decades (Krajewski, 2002). As a result, supply chain theory and practice have developed to the extent that supply chains, rather than single companies, are now seen as units of competition (Handfield, 2002). Nevertheless, supply chain management is still not well understood conceptually, and nor are future trends (Slone, 2004).

Several bodies of literature have contributed to the evolution of supply chain management theory and practice to date (Giannakis & Croom, 2004). Many investigations have focused on differing elements of exchange, at various levels of analysis and from diverse perspectives. Yet at the very heart of most emerging supply chain philosophies lie the inter-related, but only partially understood, concepts of supply chain “integration” and “collaboration”. Prominent and influential theories and frameworks have been developed to further understand the mechanisms underlying these concepts, and significant mathematical modeling and empirical evidence has built-up indicating their benefits in terms of operational performance. Nevertheless, considerable uncertainties still remain regarding these core issues despite their fundamental role in the future evolution of supply chains.

Modeling investigations of phenomena such as the “bullwhip effect” (Lee et al., 1997b) supports supply chain integration through partners working to share and coordinate flows of assets, data and information. This body of work also alludes to, but goes little further in analyzing, the need for more complex mechanisms of coordination. Empirical “arcs of integration” work has gone further by suggesting that the continued evolution of supply chain theory will require going beyond asset, data and information levels of integration to encompass human-centric issues of collaborative sharing and development of expertise and knowledge (Frohlich and Westbrook, 2001). Further literature echoes this message, citing companies that have implemented asset, data and information integration, but have been unable to sustain performance improvements. A few successful companies, however, indicate that continuing competitive advantage can be

gained by going beyond simple integration towards leveraging collaborative knowledge sharing and development with supply chain partners (Magretta, 1998b).

Regarding the future of supply chains, Bowersox et al. (Bowersox et al., 2000) bring together academic and practitioner viewpoints and asks the question: “Where are we now in the evolution of supply chains and what has to occur to advance along the continuum?” Their “mega-trends” represent key aspects in the future evolution of supply chains and reiterate the need for mechanisms that extend beyond the integration of assets, data and information, towards collaborative development and sharing of knowledge-based dimensions.

Despite the need for clearer conceptual understanding of these important knowledge-based dimensions, little academic work has been done in this area. Academics have identified such knowledge-based dimensions as representing a significant gap in the field, especially beyond the dyadic level of analysis and considering impacts on performance (Croom et al., 2000). This knowledge dimension gap, combined with calls from distinguished researchers to bring new cross-functional conceptual perspectives into supply chain literature (Stock, 1997), presents an important opportunity. Thus, a first step in addressing the “what has to occur to advance” aspect of Bowersox et al.’s (Bowersox et al., 2000) evolutionary question should be theoretical synthesis aimed at building-up just such a conceptual knowledge-base within the supply chain literature.

The emerging field of Knowledge Management is identified by this paper as a potential source of valuable insights with which to address the conceptual knowledge dimension gap in supply chain literature. An overview of streams of literature within the knowledge management field identifies several potentially relevant theories, concepts and frameworks with which to apply the “knowledge lens” to supply chain contexts (Amundson, 1998). Illuminating concepts emerge from themes such as the constituents of organizational knowledge (e.g., Kogut and Zander, 1992); the creation of knowledge (e.g., Edmonson, 1999); the transfer and adoption of knowledge (e.g., Cohen and Levinthal, 1990); and the evolution of knowledge (e.g., Argote, 1999). The very limited recent supply chain literature that has considered such knowledge management concepts confirms their appropriateness and relevance, and suggests possible “fine-tuning” for application within supply chain contexts (Bessant et al., 2003).

This paper builds upon a literature review to formulate a conceptual research framework assessing the knowledge management literature as a potential source of new insights. Research issues considering the management of knowledge in supply chains are considered in section 2. Firstly, the application of the knowledge lens to supply chains is reviewed and a unifying framework for managing knowledge in supply chains is formulated. Key dimensions are consistently used across supply chain and knowledge management literatures and working definitions are articulated. Section 3 specifies the conceptual research framework for this study, identifying broad research questions relating to knowledge transfer, supply chain competence and supply chain maturity. Finally, section 4 extracts conclusions and proposes future lines of work.

2. Managing knowledge in the supply chain

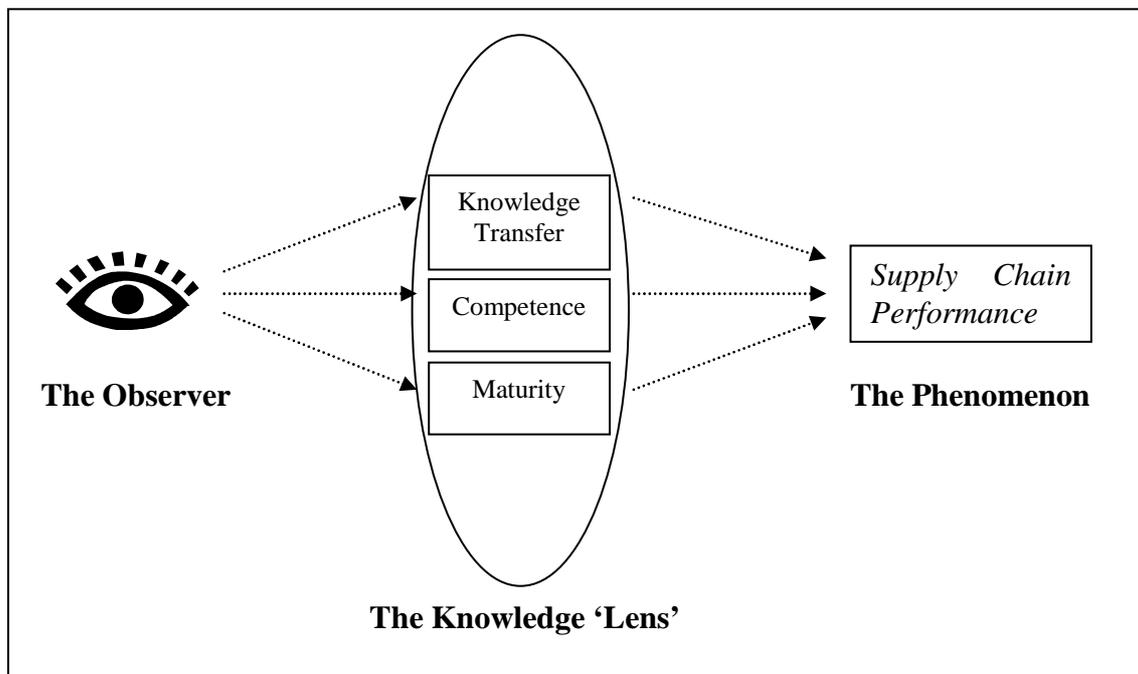
2.1. Applying the “knowledge lens” to supply chain management

When theories and new perspectives are imported from outside operations management, Amundson (Amundson, 1998) suggests that it is helpful to adopt the “lens” metaphor, whereby the notion of a theory/perspective as a lens extends the understanding of our awareness and cognitive processing.

Having identified the knowledge management literatures as potentially adding fresh perspectives, we present Figure 1 to illustrate Amundson’s (Amundson, 1998) lens as applied to the previously identified specific knowledge dimensions and supply chain issues.

Figure 1

Applying the “knowledge lens” to supply chains



To ensure that the new perspectives offered by a lens are beneficial to theory building, Amundson (Amundson, 1998) proposes four criteria for the importation of theory from other fields into operations management, namely:

1. Is the phenomenon being studied in the imported theory reasonably consistent with the operations management issues being addressed? Is there a logical argument as to why the imported theory applies to the phenomenon of interest to operations management?
2. Are the concepts being used by the imported theoretical perspective consistent with and meaningful in the field of operations management?
3. Do the concepts used in the proposed theory have significant explanatory power? Are they important concepts to managers, so that research outcomes will be of interest and use in practice?

4. Are the underlying assumptions of the theoretical perspective being employed consistent with those of operations management theoretical perspectives?

Amundson (Amundson, 1998) reviews these criteria with a view to importing and using in operations management various theory-driven empirical research theories from the literature stream of organizational learning (the “umbrella” literature for knowledge management (Argote, 1999) and concludes that assumptions inherent in knowledge management/organizational learning are consistent with views in operations management. In order to address Amundson’s (Amundson, 1998) criteria for the importation of theory from other fields, the following steps are addressed:

1. Formulating a unifying framework for managing knowledge in supply chains.
2. Ensuring that the specific constructs of knowledge transfer, competence and maturity being addressed in this study are consistently defined across the knowledge management and supply chain literatures.

2.2. A preliminary framework for supply chain knowledge management

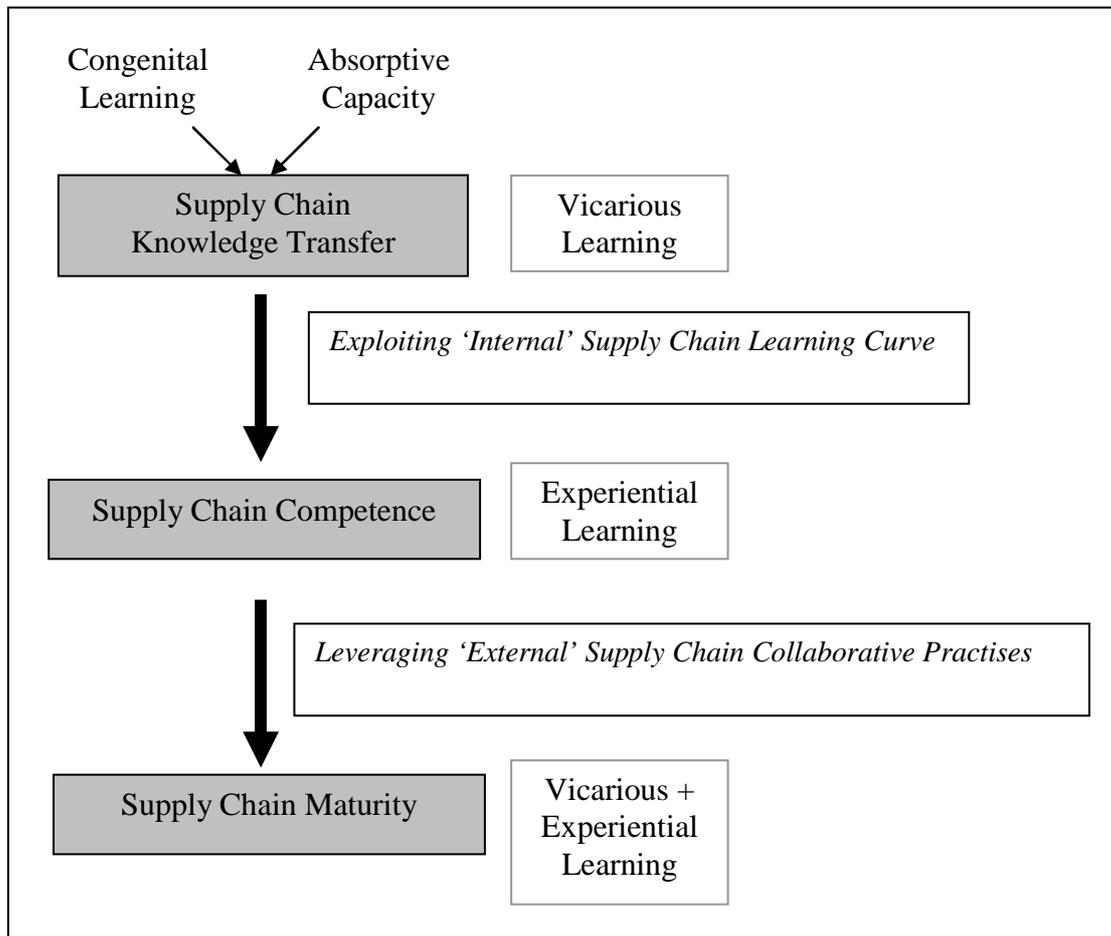
The collaborative supply chain integration literature (e.g., Frohlich and Westbrook, 2001) suggests that knowledge development across the supply chain should benefit *all* members. This, combined with knowledge management/organizational evolution literature relating to the “boundary of knowledge” (e.g., Nelson and Winter, 1982), could lead to the conclusion that the unit of analysis should be broadened beyond the single company to total supply chain knowledge management. Whilst this could be a valid aim for future research, such an extension is beyond the scope of this conceptual paper. To maintain consistency with the majority of research in both fields, this study concentrates on supply chain knowledge management issues from the perspective of the Focal Company.

The following discussion represents a preliminary effort to formulate a unifying framework for knowledge management in supply chains. Apparently, no such framework exists in the literature. The aim of formulating this framework is to aid in the theoretical understanding of the linkages between appropriate knowledge management concepts and their relevance to the supply chain setting. Figure 2 emerges from this discussion and literature synthesis, and represents one possible unifying framework that could be used to characterize the development of supply chain knowledge management.

In accordance with knowledge management literature, this study considers supply chain learning behavior to be a process that results in the development of supply chain understanding and knowledge from which the focal company can potentially benefit (Dewey, 1938; Argyris and Schon, 1978; Edmondson, 1999). Congenital learning behavior leads to the creation of an initial knowledge base composed of both explicit information (declarative knowledge) and tacit know-how (procedural knowledge) (Polyani, 1966; Kogut and Zander, 1992 ; Nonaka, 1994; Zack, 1999). This current explicit and tacit knowledge base can be augmented via further vicarious learning (from the external supply chain) and experiential learning through “learning by doing” (Huber, 1991). It is these further knowledge development mechanisms upon which the framework in Figure 2 is based.

Figure 2

A unifying framework for supply chain knowledge management



The above framework proposes three distinct phases of supply chain knowledge management:

Phase 1: In a supply chain context, vicarious learning leads to knowledge transfer from supply chain partners (Mowery et al., 1996; Ingram and Baum, 1997). Levels of previous congenital knowledge and absorptive capacity determine level of adoption of external knowledge transfers by the focal company (March and Simon, 1958; Cohen and Levinthal, 1990). Higher levels of absorptive capacity are likely for those knowledge transfers emanating from closer or more direct supply chain ties, such as 1st tier suppliers and customers (Ahuja, 2000).

Phase 2: Continued experiential learning within the focal company leads to the improvement of the knowledge base and development of supply chain competence (Levitt and March, 1988). This knowledge evolution and experience-based supply chain competence will to lead to learning curve operating performance improvements in the short term (Epple et al., 1991; Argote, 1999). Nevertheless, in the longer-term, over-exploiting internal knowledge could be self-destructive, leading to core rigidities (Leonard-Barton, 1992), competitive inertia (Miller and Chen, 1994), organizational myopia and competency traps (Levinthal and March, 1993).

Phase 3: To combat potential diminishing returns and performance-limiting phenomena in the longer term, the focal company must maintain the internal exploitation/external exploration knowledge balance (March, 1991). A combination of sustained vicarious learning through two-

way sharing of knowledge with supply chain partners (Argyris and Schon, 1978) and a move from single- to double-loop experiential learning (Almeida, 1996) is needed to sustain this balance. The collaborative transfer and implementation of appropriate supply chain practices is likely to facilitate such continuous knowledge development and learning mechanisms (Szulanski, 1996; Bessant et al., 2003); this supply chain knowledge management capitalizes on the asymmetric knowledge strengths of the different supply chain partners (Dussuage et al., 2000) and leads to true collaborative supply chain integration characterized by high levels of supply chain maturity.

A key to the above framework lies in the distinction Bowersox et al. (Bowersox et al., 2000) make between “hoarding” and “leveraging”. A focal company that hoards knowledge can only exploit the internal learning curve in the short-term. Those that engage in collaborative efforts to share knowledge and implement appropriate supply chain practices (Bessant et al., 2003), on the other hand, can leverage benefits deriving from the entire supply chain.

Another important point regarding the framework concerns the explicit and tacit forms of knowledge. Initial knowledge transfers between supply chain partners will primarily occur in the form of explicit codified knowledge, such as inventory levels, production plans and demand forecasts, delivery schedules, and *Kanban*. As knowledge evolves into internal functional competencies through learning by doing, the tacit knowledge component will increase (Kogut and Zander, 1992). Through active communication and working with supply chain partners regarding the implementation of supply chain practices, the collaborative knowledge sharing between supply chain partners will also acquire a tacit component (Szulanski, 1996). As a result, this study focuses primarily on explicit codified knowledge forms for investigation of knowledge transfer, but broadens the investigation to include tacit elements of know-how within the supply chain competence and maturity constructs.

The above three-stage framework extends the two components of supply chain learning identified by Bessant et al. (Bessant et al., 2003). Citing Teece (Teece, 1998) and Prahalad and Hamel (Prahalad and Hamel, 1994), they specify the first component to be “the accumulation and development of a core knowledge base - the ‘core competence’” deriving from “the systematic and purposive learning and construction of a knowledge base”. This corresponds to a combination of Phases 1 and 2 in the above framework. Citing Senge (Senge, 1999), Garvin (Garvin, 1993), Leonard-Barton (Leonard-Barton, 1995), and Bowen et al. (Bowen et al., 1994), Bessant et al. (Bessant et al., 2003) specify the second component of supply chain learning as “the long-term development of a capability for learning... and the growing emphasis on ‘learning organizations’”. This corresponds to the increasing supply chain maturity levels in Phase 3 in the above framework.

The above framework for supply chain knowledge management is further supported by comparison with personal, or individual, learning and knowledge development. Personal level metaphors are widely used in the knowledge management literature to explain and support the argument for organizational learning and knowledge development mechanisms. Many of the fundamental concepts of organizational learning and knowledge management originated from studies of individuals at personal and group levels (Knight, 2002). This stresses the value of experiential learning and the benefits that can come from gaining different forms of learning support from others. Part of this vision involves the idea of “comrades in adversity”, working together to tackle complex and open-ended problems (Revans, 1980). Also, Bessant and Tsekouras (Bessant and Tsekouras, 2001) and Dent (Dent, 2001) have recognized the usefulness of drawing links between personal concepts and inter-firm learning.

Therefore a useful metaphorical comparison can be made with the above framework for supply chain knowledge development, and the personal development of a qualified professional, such as an engineer, lawyer, banker, etc.

Personal Development Phase 1: Assuming an adequate level of absorptive capacity, an aspiring professional will acquire knowledge through classroom education as knowledge transfers from teacher to pupil. The graduate will leave university with raw context-independent knowledge in the form of general important skills (e.g., producing and reading engineering drawings, understanding legal jargon, general understanding of banking principles, etc.).

Personal Development Phase 2: As most employers of recent graduates are aware, their knowledge is still raw and needs to be contextualized and developed into real professional competence that is of benefit to both individual and organization within a particular business situation. This competence is developed through learning by doing and develops with time and practical on-the-job experience. Nevertheless, over time, if there is no exposure to fresh challenges and new ways of seeing things, boredom, complacency and overconfidence can creep in, with corresponding detrimental effects on personal development and performance. Therefore the move to Phase 3 is important.

Personal Development Phase 3: It is essential for the continuing professional development of an individual to be exposed to different contexts and ways of doing things. Individuals are rarely successful working in isolation of others. Successful professional development involves a continuous balance between exploiting existing competencies, and identifying and developing new ones through appraisal and training. Throughout this process the combination of feedback from others and continuing exposure to up-to-date best practices is essential. It is only through such continuous personal development efforts that an individual can attain professional maturity.

2.3. Working definitions of supply chain knowledge dimensions

Defining learning and knowledge transfer

According to The Oxford English Dictionary and The Collins English Dictionary, “learning” and “knowledge” are defined as follows:

“Learning: Verb: To gain knowledge of (something) or acquire a skill in (some art or practice). To commit to memory. To gain by experience, example, etc. To become informed.” (Collins English Dictionary)

Or: “Learning: Verb: Acquire knowledge of or skill in (something) through study or experience or by being taught. Become aware of by information or from observation. Memorize. Origin from Old English ‘lore’.” (The Oxford English Dictionary)

“Knowledge: Noun: The facts or experiences known by a person or group of people. The state of knowing. Consciousness or familiarity gained by experience or learning. Erudition or informed learning. Specific information about a subject.” (Collins English Dictionary)

Or: “Knowledge: Noun: Information and skills acquired through experience or education. The sum of what is known. Awareness or familiarity gained by experience of fact or situation.” (The Oxford English Dictionary)

In terms of adopted working definitions, the concepts of learning and knowledge transfer are consistent between knowledge management and supply chain literature streams. These dimensions are clearly defined in the knowledge based literature (e.g., Ingram and Baum, 1997; Gupta and Govindarajan, 2000) which explicitly consider the flow of knowledge between the firm and external supply chain partners. In addition, to explain the forms of knowledge, Kogut and Zander (Kogut and Zander, 1992) use the example of inventory, directly linking their relevance to a supply chain context.

Furthermore, combining the “what is knowledge?” definitions of Kogut and Zander (Kogut and Zander, 1992), Zack (Zack, 1999) and Albino et al. (Albino et al., 1999) with supply chain management definitions from Handfield and Nichols (Handfield and Nichols, 1999), Hill (Hill, 2000), and Chase et al. (Chase et al., 2001) suggests two components of knowledge transfer in the supply chain:

- The first involves the structural elements of sharing knowledge related to issues such as inventory levels, production plans, delivery frequencies, and *Kanban* systems.
- The second knowledge transfer component involves the procedural elements of coordinating, planning, and forecasting between partners in the supply chain.

Thus, knowledge transfer is a consistent construct across the literature streams. Furthermore, in the light of these definitions it is clear that knowledge is present in supply chains, that it is transferred between supply chain partners and that it is important to successful supply chain management (Bowersox et al., 2000).

Defining supply chain competence

According to The Oxford English Dictionary and The Collins English Dictionary, “competence” is defined as follows:

“Competence: the condition of being capable; ability. Competent: having sufficient skill, knowledge, etc.; capable. Suitable or sufficient for the purpose.” (Collins English Dictionary)

Or: “Competency/ competence: the quality or extent of being competent. Competent: having the necessary skill or knowledge to do something useful. Origin from Latin *competere* in the sense ‘be fit or proper’.” (Oxford English Dictionary)

Whilst being more complex than the working definitions for knowledge, “competence” is still uniformly adopted across knowledge management and supply chain streams, and thus it is appropriate to study “competence” from commonly held perspectives in both operations management and knowledge management literature streams.

From the knowledge management perspective, Levinthal and March (Levinthal and March, 1993) contend that individuals and organizations develop competence through a “mechanism of mutual positive feedback” with experience and improving knowledge and learning. This developed competence manifests itself in better skills and ways of doing things. This conforms

to the general usage of the term “competence” within the operations and supply chain management literatures.

In the operations management literature, “competence” is sometimes confused with “competitive priority”. Yet within the manufacturing literature, Corbett and Van Wassenhove (Corbett and Van Wassenhove, 1993) stress the “internal” nature of competence development as opposed to the “external” dimensions of competitiveness. Their work builds on the “focused factory” work of Skinner (Skinner, 1974), which emphasizes the importance of developing core competences that are properly aligned with competitive positioning.

Voss (Voss, 1995) identifies one paradigm of manufacturing strategy whereby the underlying argument is that “aligning the capabilities of manufacturing with the key success factors will maximize the competitiveness of a firm.” Corbett and Van Wassenhove (Corbett and Van Wassenhove, 1993) use “capability” and “competence” synonymously, supporting Ferdows and De Meyer’s (Ferdows and De Meyer, 1990) concept of cumulative competence building, otherwise known as the “sandcone” model. Corbett and Van Wassenhove (Corbett and Van Wassenhove, 1993) formulate the whole task of manufacturing strategy, and therefore of the manufacturing manager, as linking “the competences developed internally and the competitiveness required in the market.”

The above seminal works show that a significant body of operations management research has considered the development of capabilities and competences in various contexts.

Specifically regarding supply chain research, Narasimhan et al. (Narasimhan et al., 2001) state that: “Competencies are developed through a process of managing decisions across the supply chain.”

The “supply chain competence” dimension in this research considers the acquisition and improvement of created and/or transferred knowledge into specific individual and organizational experience-based, context specific competences. This use of the term “supply chain competence” is consistent with the work of Narasimhan et al. (Narasimhan et al., 2001), whereby different functional competences are components of overall supply chain competence.

Defining supply chain maturity

According to The Oxford English Dictionary and The Collins English Dictionary, “maturity” is defined as follows:

“Maturity: Noun: the state, fact or period of being mature. Mature: Adj.: Fully-grown or physically developed; adult. Like an adult in mental or emotional development. (Of thought or planning) careful and thorough. Verb: to become mature. Origin: Latin *maturus* ‘timely, ripe’.” (The Oxford English Dictionary)

Or: “Mature: Adj. Relatively advanced; grown-up. Fully grown or aged; adult e.g. a mature animal. Fully considered; perfected (plans, theories etc.) Fully developed or differentiated.” (Collins English Dictionary)

This study adopts a definition of “supply chain maturity” that maintains consistency with Bowersox et al. (Bowersox et al., 2000). To evolve along the immature to mature continuum in a supply chain context requires two-way communication to ensure “shared vision and objectives among customers and suppliers about interdependency and principles of

collaboration". In addition, development of supply chain maturity requires mutual effort between supply chain partners regarding "the adoption of integrative supply chain management operating practices".

Thus, a mature organization is defined as one that engages in extensive collaboration across a wide arc of supply chain partners in order to implement appropriate integrative practices. Conversely, an immature organization exhibits a combination of low levels of collaboration, with limited supply chain partners and across a limited range of supply chain integration practices.

This use of an organizational maturity term is consistent with the knowledge management aims of a "learning organization" that seeks to balance the internal exploitation of existing knowledge with the exploration of new external knowledge possessed by supply chain partners. Hyland et al. (Hyland et al., 2003) suggest that this is liable to be a continuous process. Therefore, the emphasis in the development of supply chain maturity is on the sustained combination of continuous experiential and vicarious learning, through the development and sharing of appropriate supply chain practices. Also Miller and Chen (Miller and Chen, 1994) suggest that more mature organizations could reduce problems associated with "competitive inertia" through prolonged internal knowledge exploitation and external exploration. In essence, then, this maturity construct constitutes the long-term combination of regularly updated competence levels and the use of the correct tools for the circumstances.

3. Proposed research models

As the framework in Figure 2 indicates, the knowledge dimensions of knowledge transfer, supply chain competence and supply chain maturity also represent a logical progression from creation/transfer, through acquisition/improvement, and finally to evolution of knowledge in the supply chain. The first two knowledge dimensions of knowledge transfers and supply chain competence are purely derived from mechanisms of knowledge and skill development in the supply chain. Supply chain maturity, on the other hand combines knowledge evolution in the supply chain with the implementation of appropriate supply chain practices. These three issues have been identified as potential drivers of performance that warrant further empirical study in supply chain contexts. Thus, Bowersox et al.'s (Bowersox et al., 2000) evolutionary research question from section 1 can be broken-down into the following, more meaningfully articulated research questions:

1. What is the impact of supply chain knowledge transfer on performance?
2. What is the impact of supply chain competence on performance?
3. What is the impact of supply chain maturity on performance?

These three research questions start to address the knowledge dimension gap in the supply chain literature.

Proposed research model 1: Knowledge transfer in supply chains

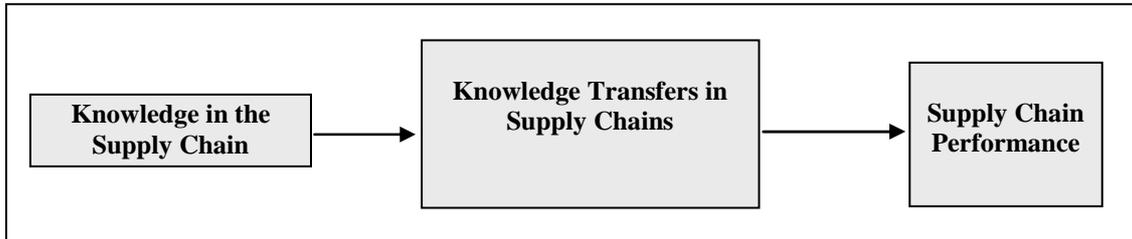
An exploratory investigation of knowledge transfers in the context of manufacturing and/or service supply chains can address the first broad research question:

RQ1: What is the impact on performance of knowledge transfer in supply chains?

This research question corresponds to the framework shown in Figure 3.

Figure 3

Proposed research model 1: Knowledge transfer in supply chains



The knowledge management and supply chain literatures parallel each other in the general proposition that external knowledge is transferred between supply chain partners, and that this knowledge transfer can significantly benefit organizational efficiency. The supply chain integration literature consistently notes the benefits of sharing data and information with and coordinating activities between supply chain partners in order to improve performance (e.g., Davis, 1993; Fisher et al., 1994; Fisher, 1997; Lee et al., 1997a; Magretta, 1998).

From the knowledge management literature there is abundant evidence that organizational knowledge is an important determinant of higher performance and greater competitiveness (e.g., Brown and Duguid, 1991; Kogut and Zander, 1992). Several studies have demonstrated the beneficial value of knowledge transfers from beyond the boundaries of the organization (e.g., Cohen & Levinthal, 1990; Hagedoorn & Schekenraad, 1994; Mowery et al., 1996).

Thus, from the combined supply chain and knowledge management literature, the following proposition can be made:

Proposition 1: Knowledge transfer between supply chain partners will enhance supply chain performance.

This proposition warrants analysis to identify mechanisms of external knowledge transfer in the supply chain, and links with improved organizational efficiency.

Whilst there are similarities between knowledge management and supply chain management literatures, there are also differences. For example, there is no fine-tuning of the relative benefits depending on where knowledge transfers emanate from: while the knowledge management literature recognizes that not all knowledge creation, capture, and distribution are equal (e.g., Levinthal and March, 1993; Miller and Chen, 1994; Ingram and Baum, 1997), it makes no distinction between upstream, downstream or integrated supply chain external knowledge sources. Similarly, the benefits of supply chain integration have not yet been demonstrated at the knowledge level of exchange. Thus, adequate exploration of the above primary research question and literature-derived proposition could also lead to valuable insights and answers to the following secondary research questions:

RQ1a: Is the concept of an integrated supply chain supported from a knowledge perspective?

RQ1b: Where does the 'richest' knowledge in a supply chain emanate from?

A further point of consideration in any such further study concerns the type of knowledge to investigate. A full consideration of tacit knowledge would represent a significant increase in complexity to an initial exploratory investigation. Thus, while any such research should recognize the importance of managing both tacit and explicit knowledge in organizations (Polyani, 1966; Brown and Duguid, 1991; Nonaka, 1994; Romer, 1995), we contend the validity of focusing on the codified explicit form for two reasons:

1. Explicit knowledge plays an increasingly general role in modern organizations,
2. It is more precisely formulated and articulated than tacit knowledge, thus enabling accurate and focused empirical analyses (Zack, 1999).

Investigating explicit knowledge is thus ideally suited to an exploratory study. Results are more likely to be accurate and generalizable to other contexts in subsequent investigations. By contrast, including the more complex and context-specific tacit know-how could be detrimental to such focus and generalizability for exploratory studies.

Proposed research model 2: Comparing supply chain competence across traditional and evolving contexts

Supply chain concepts that have been developed and observed in traditional (manufacturing) contexts are being extended and implemented in new contexts such as service operations. These evolving service supply chain contexts pose new challenges both to practitioners and to researchers, and present interesting manufacturing-service comparative research opportunities. The second area of proposed research is aimed at contributing to the literature by investigating whether a supply chain competence construct is equally applicable and valid across traditional and evolving contexts.

In order to draw comparisons between the distinct traditional and evolving operations, it is necessary to pin down what supply chain competence constructs are and in which parts of the supply chain. The downstream side of manufacturing and service supply chains can differ considerably in terms of what is delivered to the end customer and how it is delivered. Therefore there are limited grounds for comparison here. On the upstream- supplier side however, there are significant operational similarities. In the same way that manufacturing requires the supply of raw materials and component products, services often also rely on the provision of physical goods from upstream suppliers.

Previous studies consistently link upstream supply chain competence to benefits in terms of:

- Reduced costs and lead times (Ansari and Modaress, 1990)
- Improved supplier reliability (Carr and Pearson, 1999)
- Improved communications (Freeland, 1991)

The literature consistently contends that these benefits in turn lead to improved operational performance in manufacturing organizations (Chapman and Carter, 1990; Akinc, 1993; Lawrence and Hottenstein, 1995; Agrawal and Nahmias, 1997; Tan et al., 1998). Yet these benefits would clearly also be appreciated by most service organizations that undertake purchasing of physical goods.

As long as dimensions related to common knowledge are used, valid comparisons can be made. In this respect, Narasimhan et al. (Narasimhan et al., 2001) define supply chain competence as a function of purchasing competence, manufacturing competence and marketing/sales competence.

Thus, this second proposed study adopts the supply chain purchasing competence construct that Narasimhan et al. (Narasimhan et al., 2001) empirically identified for manufacturing, and aims to replicate and cross-validate it across manufacturing and service companies. The following research question therefore emerges for investigation in the second proposed study:

RQ2a: Is supply chain purchasing competence equally valid for both traditional and evolving supply chain contexts?

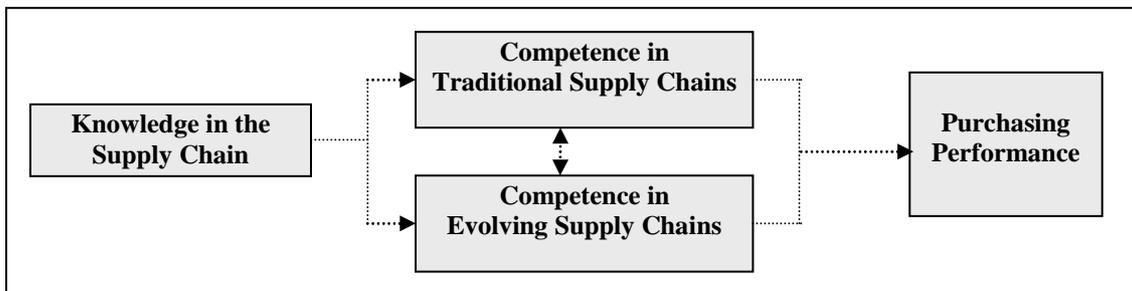
To investigate the impacts on performance of supply chain purchasing competence, in both traditional and evolving contexts, common scales of performance need to be used. In this respect, Chao (Chao, 1993) identified the most important multi-sector purchasing performance measures, thus providing a basis upon which to study the following research question:

RQ2b: What are the impacts on performance of supply chain competence dimensions in manufacturing and service contexts?

These research questions correspond to the framework shown in Figure 4.

Figure 4

Proposed research model 2: Comparing supply chain competence across traditional and evolving contexts



Regarding the impact of supply chain competence on performance, both supply chain and knowledge management literatures propose the potential beneficial impact of competence development on performance. The combined supply chain and knowledge management literatures thus lead to the following proposition:

Proposition 2: Supply chain competences will have a significant impact in manufacturing and evolving service supply chains.

Nevertheless, whilst the supply chain literature simply proposes a significant positive impact, the knowledge management literature also recognizes the potential for significant negative impact of competence development on performance. Work on learning curves in organizations (Epple et al., 1991) indicate possible diminishing returns, and some literature warns of the dangers of over-optimizing knowledge (Starbuck and Milliken, 1988). Performance trade-offs

have been identified between exploiting existing competences and exploring new knowledge (March, 1991). Also, the research on corporate inertia and competency traps recognizes that, while applying existing knowledge-based competence might be beneficial, it might also make an organization myopic and rigid (Levinthal and March, 1993; Miller and Chen, 1994).

Proposed research model 3: Investigating supply chain maturity

The term “supply chain maturity” was coined by Bowersox et al. (Bowersox et al., 2000), and inkeeping with their usage, is considered in this study as the level of collaboration with supply chain partners pertaining to appropriate supply chain practice implementation.

Maturity levels differ between companies and sectors. Generally, the manufacturing sector is considered to be comparatively mature since, on the whole, it has widely implemented supply chain practices and worked to share knowledge with supply chain partners for many years. On the other hand, however, supply chain practices and collaborative knowledge sharing are comparatively new in certain evolving service supply chains.

As such, there is likely to be a greater spread in supply chain maturity levels between fast adopter and laggard service organizations. This likely increased spread in maturity makes evolving service supply chain contexts particularly interesting arenas for further investigation. Thus, we propose that a significant contribution could be made to the literature by assessing the impact of supply chain maturity on operational performance in a specific sector where a service provider depends on product suppliers.

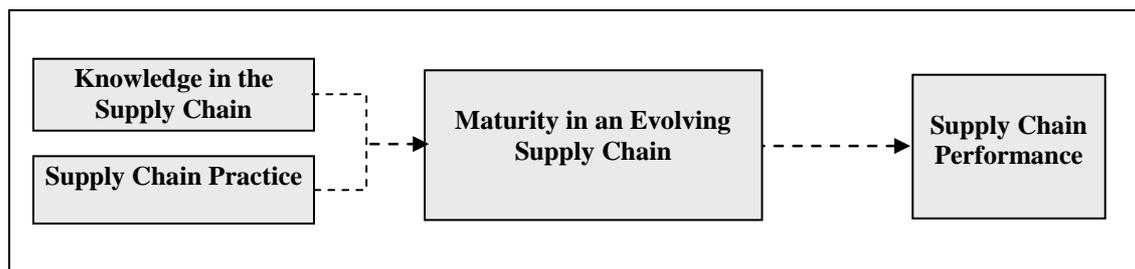
Thus the third broad research question is contextually refined to:

RQ3: What is the impact on performance of supply chain maturity in an evolving supply chain context?

This research question corresponds to the framework shown in Figure 5.

Figure 5

Proposed research model 3: Invetigating supply chain maturity



Given that the maturity dimension is composed of both knowledge and practice components, particular care needs to be taken in its formulation. Despite an extensive review of the literature, no formal operationalization of the supply chain maturity concept was found in an adequately detailed form for the purposes of future study. Therefore, proposed model 3 would seek to develop a new supply chain maturity construct, whilst aiming to stay as true as possible to the usage of the term by Bowersox et al. (Bowersox et al., 2000). This leads to the following additional research question:

RQ3a: What are the underlying dimensions of supply chain maturity?

Regarding the inclusion of supply chain practice aspects in the maturity construct, the Supply Chain Council (Supply Chain Council, 2004) SCOR model might prove invaluable. The practices identified under each of the Plan, Source, Deliver, Make, NPD and Returns elements of the SCOR model might be found to be appropriate to an overall supply chain maturity construct. Nevertheless, it should not be assumed that all of these SCOR practices are necessarily appropriate to all situations. In fact, proposed study 3 should not attempt to develop a “one size fits all” supply chain maturity construct, but rather put the onus on validating the concept based on appropriate supply chain practices, according to context-specific supply chain operational configurations (Bessant et al., 2003). Thus, the following proposition emerges:

Proposition 3a: Supply chain maturity can be defined in terms of knowledge sharing across practices that are appropriate to specific operational supply chain configurations.

Both supply chain and knowledge management literatures suggest the potential impact on performance from combined collaborative knowledge sharing and appropriate practice implementation. Thus the following additional proposition emerges from the literatures:

Proposition 3b: Supply chain maturity will have a significant impact on performance.

Yet, as with supply chain competence, the supply chain and knowledge management literatures do not give universal agreement regarding the direction of this impact on performance. Whilst some literature (e.g., Bowersox et al., 2000) only considers a beneficial impact on performance from the combination of up-to-date supply chain practices, and high levels of knowledge sharing, others warn of potential negative impact. Some supply chain literature indicates that not all supply chain practices are necessarily appropriate (Davenport, 1998). In addition, some knowledge and operations management literature warns that knowledge sharing and development activities in certain areas do not necessarily lead to performance improvement (Upton, 1995; Vokurka and O’Leary-Kelly, 2000). In fact, certain performance diminishing phenomena could lead to an insignificant or negative impact of supply chain maturity on performance depending on the contingencies present in differing supply chain configurations (Leonard-Barton, 1992).

4. Conclusions and suggestions for future research

From a synthesis of relevant supply chain and knowledge management literatures, a conceptual framework for supply chain knowledge management has been formulated. This framework comprises mechanisms associated with the dimensions of knowledge transfer between supply chain partners, the development of supply chain competence, and the evolution of supply chain maturity.

From the development of this conceptual framework, three specific proposals for future research are made and associated research models are generated. The three proposed research models are aimed at contributing to the supply chain literature.

The first area of proposed exploratory research is to investigate the impacts on performance of knowledge transfer in traditional supply chains. The second area of proposed comparative research is to investigate the impact on performance of supply chain competence, as well as determining whether such a competence construct is equally applicable and valid across

traditional and evolving contexts. And, finally, the third area of proposed research is to assess the impact of supply chain maturity on operational performance in evolving contexts.

From the combined knowledge management and supply chain literatures, propositions are made suggesting the potential impact on performance of each of the above knowledge-based constructs. Nevertheless, care needs to be exercised whenever theories and constructs are embraced from outside a body of literature to ensure appropriate, consistent and reliable application. That such concepts and constructs have universal application cannot be assumed.

Whilst there are similarities between knowledge management and supply chain literatures, there are also differences. Some knowledge and operations management literature warns that knowledge sharing and development activities do not necessarily lead to performance improvement. Thus, adequate exploration of the proposed research questions could also lead to valuable further insights and answers to additional secondary questions in future investigations.

5. References

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