

## Understanding supply chain management: critical research and a theoretical framework

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Increasing global cooperation, vertical disintegration and a focus on core activities have led to the notion that firms are links in a networked supply chain. This strategic viewpoint has created the challenge of coordinating effectively the entire supply chain, from upstream to downstream activities. While supply chains have existed ever since businesses have been organized to bring products and services to customers, the notion of their competitive advantage, and consequently supply chain management (SCM), is a relatively recent thinking in management literature. Although research interests in and the importance of SCM are growing, scholarly materials remain scattered and disjointed, and no research has been directed towards a systematic identification of the core initiatives and constructs involved in SCM. Thus, the purpose of this study is to develop a research framework that improves understanding of SCM and stimulates and facilitates researchers to undertake both theoretical and empirical investigation on the critical constructs of SCM, and the exploration of their impacts on supply chain performance. To this end, we analyse over 400 articles and synthesize the large, fragmented body of work dispersed across many disciplines such as purchasing and supply, logistics and transportation, marketing, organizational dynamics, information management, strategic management, and operations management literature.

### 1. Introduction

The popularity of the supply chain concept has been stimulated from many directions including the quality revolution (Dale *et al.* 1994), notions of materials management and integrated logistics (Carter and Price 1993), a growing interest in industrial markets and networks (Ford 1990, Jarillo 1993), the notion of increased focus (Porter 1987, Snow *et al.* 1992), and influential industry-specific studies (Womack *et al.* 1991, Lamming 1993). Thus, researchers find themselves inundated with a plethora of terminology including ‘supply chains’, ‘demand pipelines’ (Farmer and Van Amstel 1991), ‘value streams’ (Womack and Jones 1994), ‘support chains’, and many others.

The origins of the notion of supply chain management (SCM) are unclear, but its development appears to start along the lines of physical distribution and transport (Croom *et al.* 2000), based on the theory of Industrial Dynamics, derived from the work of Forrester (1961). Another antecedent can be found in the total cost approach to distribution and logistics (Heckert and Miner 1940, Lewis 1956). Both approaches show that focusing on a single element in the chain cannot

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Revision received April 2003.

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assure the effectiveness of the whole system (Croom *et al.* 2000). The term ‘supply chain management’ was originally introduced by consultants in the early 1980s (Oliver and Webber 1992) and has subsequently gained tremendous attention (La Londe 1998). Analytically, a typical supply chain (figure 1) is simply a network of materials, information and services processing links with the characteristics of supply, transformation and demand.

The term ‘supply chain management’ has not only been used to explain the logistics activities and the planning and control of materials and information flows internally within a company or externally between companies (Christopher 1992, Cooper *et al.* 1997b, Fisher 1997). Researchers have also used it to describe strategic, interorganizational issues (Cox 1997, Harland *et al.* 1999), to discuss an alternative organizational form to vertical integration (Thorelli 1986, Hakansson and Snehota 1995), to identify and describe the relationship a company develops with its suppliers (e.g. Helper 1991, Hines 1994, Narus and Anderson 1995), and to address the purchasing and supply perspective (e.g. Morgan and Monczka 1996, Farmer 1997).

Various subject areas such as purchasing and supply, logistics and transportation, marketing, organizational behaviour, network, strategic management, management information systems and operations management have contributed to the explosion of SCM literature. From the myriad of research, it can be seen that a great deal of progress has been made toward understanding the essence of SCM. The new orthodox of SCM, however, is in danger of collapsing into a discredited management fad unless a reliable conceptual basis is developed (New 1996), and many authors have highlighted the pressing need for clearly defined constructs and conceptual frameworks to advance the field (New 1995, Saunders 1995, 1998, Cooper *et al.* 1997a, Babbar and Prasad 1998).

Towards the journey of developing a common conceptual base, we examine and consolidate over 400 articles from diverse disciplines mentioned above. The contributions from the various studies exist in isolation, but taken together, they have many of the critical elements necessary for successful management of supply chains. This study may be the most comprehensive analysis of the multi-disciplinary, wide-ranging research on SCM. Therefore, this study first contributes a coherent presentation and classification of current body of supply chain knowledge. The analysis of selected SCM literature is presented in the following two sections: *critical SCM elements* and *supply chain performance*. We then identify relevant findings and integrate them into an empirically tractable, meaningful

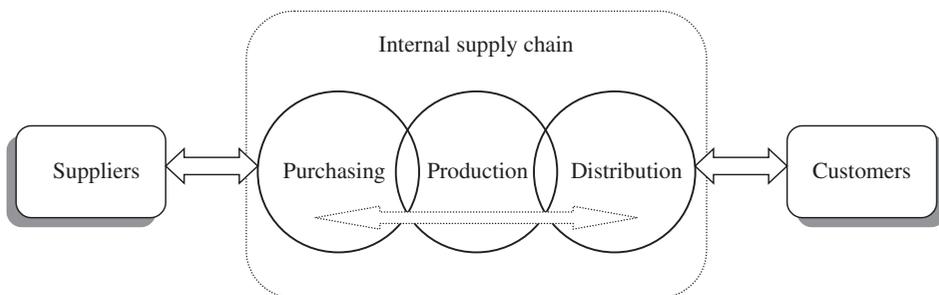


Figure 1. Company's supply chain.

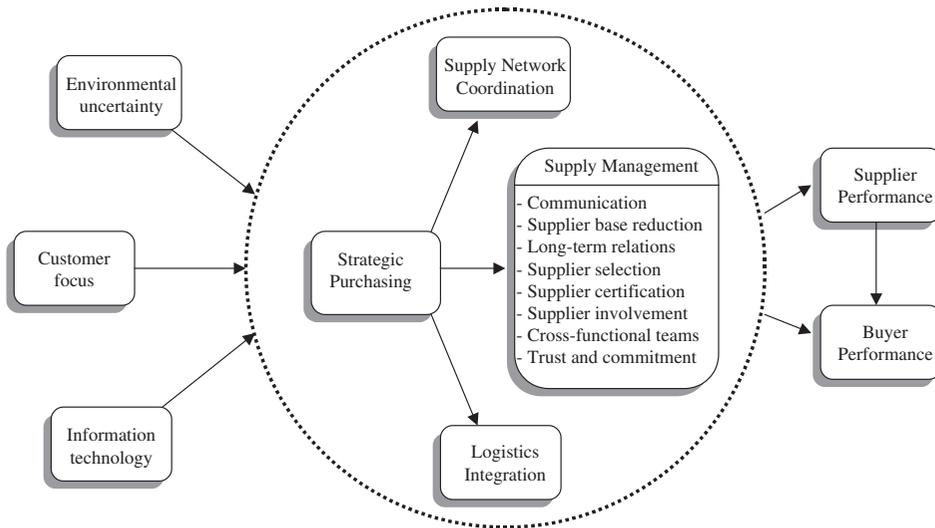


Figure 2. Theoretical framework for supply chain management research.

research framework. Thus, the development of a research framework of SCM (figure 2) is a second contribution. The pressing need and value of a conceptual framework conducive and instrumental to further research have recently been accentuated in operations management literature (Chen and Small 1996, Ho *et al.* 2002). The framework illustrated in figure 2 can help managers to understand better the scope of both problems and opportunities associated with SCM. It shall also be of great value not only to readers who desire to extend their research avenues into this exciting area, but also to those who have already investigated this topic, but in isolation or with limited scope. In addition to highlighting an emerging and important area of inquiry, a third contribution of this work is to respond to a call for theory building in operations management (e.g. Meredith 1998, Melnyk and Handfield 1998). The critical elements identified herein help contribute to the development of SCM constructs, recognizing that construct measurement development is at the core of theory building (Venkatraman 1989). The research framework developed in this study can be further refined or expanded into various theoretical models, thereby allowing researchers to test the validity of and relationships among the critical constructs along with their impact on supply chain performance, and ultimately to create a coherent theory of SCM.

## 2. Critical elements of SCM

To facilitate the comprehension of the scope of SCM research and the critical supply chain elements and activities examined in this paper, an overview of our research framework is shown in figure 2. The development and justification of the framework will be presented in greater detail in section 4. As figure 2 depicts, the three driving forces help lead to the development of the notion of SCM. Companies have since undertaken various initiatives and approaches and addressed an assortment of issues related to their supply chains. These approaches and initiatives, classified into four streams of research efforts: *strategic purchasing*, *supply management*, *logistics integration*, and *supply network coordination*, are carefully analysed

here as they contribute to the core of SCM literature and are believed to have a significant impact on the performance of supply chain members.

### 2.1. *Strategic purchasing*

Historically, purchasing has been considered to have a passive role in the business organization (Ammer 1989, Fearon 1989). In the 1980s, purchasing was seen to be involved in the corporate strategic planning process (Spekman and Hill 1980, Carlisle and Parker 1989). By the 1990s, both academics and managers were giving much more attention to strategic purchasing (Freeman and Cavinato 1990, Pearson and Gritzmacher 1990, Watts *et al.* 1992, Gadde and Hakansson 1993, Laming 1993, Ellram and Carr 1994). The ability of purchasing to influence strategic planning has increased due to the rapidly changing competitive environment (Spekman *et al.* 1994, Carter and Narasimhan 1996).

The conceptual re-description of purchasing as the integration of internal and external exchange functions is affiliated with many neo-classical tasks of industrial purchasing such as measuring internal customer's perception of purchasing's service quality (Young and Varble 1997), making entrepreneurial ventures through innovation, risk-taking and proactiveness (Morris and Calantone 1991), and establishing cooperative supplier relationships to match a firm's competitive stance (Landeros and Monczka 1989, Watts *et al.* 1992). The perspective of strategic purchasing is also consistent with general strategy literature (Carr and Smeltzer 1999). Pearson *et al.* (1996) state that strategic purchasing also has a proactive, long-term focus. Increasingly evidence reveals that purchasing is increasingly assuming its strategic role. For example, more purchasing professionals are now trained in cross-functional areas and strategic elements of the competitive strategy (Reck and Long 1988), purchasing selects the right type of relationship with its suppliers and supplier relationships are strategically managed (Keough 1994), and purchasing performance is measured in terms of contributions to the firm's success (Reck and Long 1988, Aguillar 1992). The strategic recognition is perhaps best evidenced by a recent action taken by the US National Association of Purchasing Management (NAPM), founded in 1915. In May 2001, the NAPM membership voted to change the association's name to the Institute for Supply Management (ISM) to reflect the increasing strategic and global significance of purchasing. Contemporary purchasing is now best recognized as a critical unit of SCM (Gadde and Hakansson 1994, Fung 1999).

A number of studies have addressed the imperative role of strategic purchasing in SCM (e.g. Carter and Narasimhan 1996, Pearson *et al.* 1996, Carr and Smeltzer 1997, 1999, Krause *et al.* 2001, Carr and Pearson 1999, 2002). Considerable amounts of literature have also discussed the merits of strategic supplier relationships (e.g. Heidi and John 1990, Carr and Pearson 1999, Krause 1999, Shin *et al.* 2000). In particular, Carr and Pearson study the relationships of strategic purchasing, buyer-supplier relationships, supplier evaluation system, and performance outcomes. Shin *et al.* (2000) test the impact of supply management orientation on suppliers' and buyers' performance.

### 2.2. *Supply management*

Supply management is different from SCM in that SCM emphasizes all aspects of delivering products and services to customers, whereas supply management emphasizes primarily the buyer-supplier relationship (Leenders *et al.* 2002). Fuelled by the

strategic recognition and extended role of purchasing, buyer–supplier relationship or supply management has drawn unprecedented interest in SCM literature. Note that since suppliers have a profound and direct impact on cost, quality, time and responsiveness of the buying firms, the management of business and relationships with other members of the supply chain (i.e. buyer–supplier relationship) is increasingly being referred to as SCM.

While some researchers argue that the conceptualization of SCM should be broader than defining it in terms of a firm's involvement in managing relationships with its suppliers (e.g. Ho *et al.* 2002), this perspective has been the predominant approach to SCM research. The prevalence of this approach appears to have benefited drastically from the increasing globalization of markets and the trendy practice of strategic purchasing. The prodigious research efforts of this approach to SCM are evidently visible in table 1.

### 2.2.1. *Communication*

Effective two-way communication is demonstrated throughout the literature as essential to successful supplier relationship (Lascelles and Dale 1989, Ansari and Modarress 1990, Hahn *et al.* 1990, Newman and Rhee 1990, Galt and Dale 1991, Krause 1999). Effective interorganizational communication could be characterized as frequent, genuine, and involving personal contacts between buying and selling personnel (Krause and Ellram 1997). In order to jointly find solutions to material problems and design issues, buyers and suppliers must commit a greater amount of information and be willing to share sensitive design information (Giunipero 1990, Carr and Pearson 1999). This is often achieved through engineer-to-engineer communication on design issues, in order to improve process capability, manufacturability, and performance without affecting profit margins (Bhote 1987, Dobler *et al.* 1990, Turnbull *et al.* 1992). When communication occurs among design, engineering, quality control and other functions between the buyer and supplier firms, in addition to the purchasing–sales interface, the supplier's quality performance is superior to that experienced when only the buying firm's purchasing department and supplier's sales department act as the interfirm information conduit (Carter and Miller 1989). Furthermore, many supplier product problems were due to poor communication (Newman and Rhee 1990). Poor communication was often a fundamental weakness in the interface between a buying firm and its supplier, which undermined the buying firm's efforts to achieve increased levels of supplier performance (Lascelles and Dale 1989). In their 10 case studies of buying firms in the UK, Galt and Dale (1991) revealed the importance of two-way communication with suppliers and its potential positive effect on the buying firm's competitiveness.

### 2.2.2. *Supplier base reduction*

The traditional practice of firms contracting with multiple suppliers, even for the same material or component, was based on the premises that (1) competition is the basis of the economic system, (2) purchasing must not become source dependent and (3) multiple sourcing is a risk-reducing technique (Newman 1989, Shin *et al.* 2000). Reduction of the supplier base, however, is a unique characteristic of contemporary buyer–supplier relationships (Newman 1988b, Helper 1991), because the administrative or transaction costs associated with managing a large number of vendors often outweigh the benefits (Dyer 2000). Many firms are reducing the number of primary suppliers and allocating a majority of the purchased material requirements

Main area	Subarea	Reference
Strategic purchasing		Aguillar (1992) Ammer (1989) Carlisle and Parker (1989) Carr and Smeltzer (1997, 1999) Carr and Pearson (1999, 2002) Carter and Narasimhan (1996) Ellram and Carr (1994) Fearson (1989) Freeman and Cavinato (1990) Fung (1999) Gadde and Hakansson (1993) Heidi and John (1990) Keough (1994) Krause (1999) Krause <i>et al.</i> (2001) Lamming (1993) Landeros and Monczka (1989) Morris and Calantone (1991) Pearson and Gritzmacher (1990) Pearson <i>et al.</i> (1996) Reck and Long (1988) Shin <i>et al.</i> (2000) Spekman and Hill (1980) Spekman <i>et al.</i> (1994) Young and Varble (1997) Watts <i>et al.</i> (1992)
Supply management	communication	Ansari and Modarress (1990) Bhoté (1987) Carr and Pearson (1999) Carter and Miller (1989) Dobler <i>et al.</i> (1990) Galt and Dale (2001) Giunipero (1990) Hahn <i>et al.</i> (1990) Krause (1999) Lascelles and Dale (1989) Newman and Rhee (1990) Turnbull <i>et al.</i> (1992)
Supply management	supplier base reduction	Bozarth <i>et al.</i> (1998) Burt (1989) De Toni and Nassimbeni (1999) Dyer (2000) Hahn <i>et al.</i> (1986) Handfield (1993) Helper (1991) Kekre <i>et al.</i> (1995) Mohr and Spekman (1994) Manoocheri (1984) Morgan (1987) Newman (1988a, b) Newman (1989) Offodile and Arrington (1992) Pilling and Zhang (1992) Raia (1988, 1993) Richardson (1993) Russell and Krajewski (1992) Shin <i>et al.</i> (2000) Spekman (1988) St. John and Heriot (1993) Trevelen (1987)
Supply management	long-term relationships	Carr and Pearson (1999) Choi and Hartley (1996) Christopher (1992) Cooper and Ellram (1993) De Toni and Nassimbeni (1999) Dyer (1997, 2000) Hahn <i>et al.</i> (1983) Hakansson (1987) Helper (1991) Helper and Sako (1995) Hines (1994) Johnston and Lawrence (1990) Kotabe <i>et al.</i> (2003) Lamming (1993) Landeros and Monczka (1989) Lorenzoni and Ornait (1988) Macbeth and Ferguson (1994) Nishiguchi (1994) Sabel <i>et al.</i> (1987) Slack (1991) Stuart (1993) Womack <i>et al.</i> (1991)
Supply management	supplier selection	Anderson and Narus (1990) Bailey <i>et al.</i> (1994) Baxter <i>et al.</i> (1989) Choi and Hartley (1996) Croom (1992, 2001) Dempsey (1978) Dickson (1966) Dyer (1997) Ellram (1990) Helper (1991) Ittner <i>et al.</i> (1999) Lewis (1995) Manoocheri (1984) Narasimhan (1983) Treleven (1987) Weber <i>et al.</i> (1991) Willis and Huston (1989)
Supply management	supplier certification	American Quality Foundation and Ernst and Young (1998) Baiman <i>et al.</i> (1998) Carr and Ittner (1992) Ellram and Siferd (1998) Grieco (1989) Gibson <i>et al.</i> (1995) Heide and John (1990) Inman and Hubler (1992) Ittner <i>et al.</i> (1999) Jancsurak (1992) Larson and Kulchitsky (1998) Lockhart and Ettkin (1993) Maass <i>et al.</i> (1990) Murphy (1992) Schneider <i>et al.</i> (1995)
Supply management	supplier involvement	Aleo (1992) Birou and Fawcett (1994) Burt and Soukup (1985) Burton (1988) Cayer (1988) Clark (1989) Clark and Fujimoto (1991) Dowlatshahi (1998, 2000) Eisenhardt and Tabrizi (1994) Hakansson and Eriksson (1993) Helper (1991) Hines (1994) Karmath and Liker (1994) LaBahn and Krapfel (1994) Lamming (1993) Mabert <i>et al.</i> (1992) Naumann and Reck (1982) Primo and Amundson (2002) Ragatz <i>et al.</i> (1997, 2002) Shin <i>et al.</i> (2000) Swink (1999) Wynstra and Pierick (2000) Wynstra <i>et al.</i> (2000)

Supply management	cross-functional teams	Burt (1989) Burt and Doyle (1993) Davidow and Malone (1992) Deeter-Schmelz and Ramsey (1995) Drew and Coulson-Thomas (1997) Ellram and Pearson (1993) Hahn <i>et al.</i> (1990) Handy (1990) Hastings (1993) Helfert and Gemunden (1998) Helfert and Vith (1999) Hines (1994) Krause and Elram (1997) Moon and Armstrong (1994) Narus and Anderson (1995) Smith and Barclay (1993)
Supply management	trust and commitment	Dion <i>et al.</i> (1992) Dyer (1997) Handfield and Bechtel (2002) Heidi and John (1990) Hill (1990) Kumar (1996) Lee and Billington (1992) Nooteboom <i>et al.</i> (1997) Spekman <i>et al.</i> (1998) Zaheer and Venkatraman (1995) Zaheer <i>et al.</i> (1998)
Logistics integration	general	Caputo (1996) Caputo and Mininno (1998) La Londe (1983) Langley and Holcomb (1992) Vollman <i>et al.</i> (1997)
Logistics integration	internal integration	Appley and Winder (1977) Ballow <i>et al.</i> (2000) Bowersox and Daugherty (1987) Bowersox <i>et al.</i> (1992) Cespedes (1996) Ellinger (2000) Gray (1989) Griffin and Hauser (1996) Kahn (1996) Kahn and Mentzer (1996) Kent and Flint (1997) Kingman-Brundage <i>et al.</i> (1995) Liedtka (1996) McGinnis and Kohn (1990) Moenaert <i>et al.</i> (1994) Rinehart <i>et al.</i> (1989) Schrage (1990) Souder (1987) Stank <i>et al.</i> (1999) Stolle (1967) Tjosvold (1988)
Logistics integration	external integration	Armistead and Mapes (1993) Ballou <i>et al.</i> (2000) Berry <i>et al.</i> (1994) Bowersox (1997) Bowersox and Closs (1996) Bowersox <i>et al.</i> (1988) Busch (1988) Christopher (1994) Cooper <i>et al.</i> (1997b) Dolan (1987) Drew and Smith (1995) Fox (1991, 1992) Greis and Kasarda (1997) Gustin <i>et al.</i> (1995) La Londe <i>et al.</i> (1970) La Londe and Powers (1993) Lambert and Stock (1993) Larson (1994) McGinnis and Kohn (1990) Morash (1990) Morash <i>et al.</i> (1997) Stock (1990) Stock and Lambert (1992) Stock <i>et al.</i> (1998, 2000) Towill (1997) Vonderembse <i>et al.</i> (1995) Walton and Marucheck (1997) Wasik (1992)
Supply network coordination	general	Chandra and Fisher (1994) Ernst and Pyke (1993) Forrester (1958, 1961) Goyal (1988) Lau and Lau (1994) Lee <i>et al.</i> (1997)
Supply network coordination	survey articles	Beamon (1998) Erenguc <i>et al.</i> (1999) Sahin and Robinson (2002) Thomas and Griffin (1996)
Supply chain performance	financial	Beamon (1999) Chen and Lee (1995) Dixon <i>et al.</i> (1990) Eccles and Pyburn (1992) Geanuracos and Meiklejohn (1993) Hall (1983) Hofer (1983) Johnson and Kaplan (1987) Kaplan (1988) Medori <i>et al.</i> (1995) Neely (1998) Neely <i>et al.</i> (1995) Skinner (1971) Tarr (1995) Venkatraman and Ramanujam (1987)
Supply chain performance	operational	Beamon (1999) Chen and Lee (1995) Eccles and Pyburn (1992) Medori (1998) Medori <i>et al.</i> (1995) Medori and Steeple (2000) Neely (1998)
Supply chain performance	supply chain	Beamon (1999) Bello and Gilliland (1997) Fawcett and Clinton (1996) Gunasekaran <i>et al.</i> (2001) Handfield (1995) Handfield and Pannesi (1992) Hendrick (1994) Jayaram <i>et al.</i> (1999) Kaplan and Norton (1996a, b) Roth and Miller (1990) Safizadeh <i>et al.</i> (1996) Stalk and Hout (1990) Tersine and Hummingbird (1995) Tunc and Gupta (1993) Vickery <i>et al.</i> (1995)

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Table 1. Selected review of the supply chain management literature.

to a single source (Manoocheri 1984, Hahn *et al.* 1986, Spekman 1988, Pilling and Zhang 1992, Kekre *et al.* 1995). This action provides multiple benefits including: (1) fewer suppliers to contact in the case of orders given on short notice, (2) reduced inventory management costs (Trevelen 1987), (3) volume consolidation and quantity discounts, (4) increased economies of scale based on order volume and the learning curve effect (Hahn *et al.* 1986), (5) reduced lead times due to dedicated capacity and work-in-process inventory from the suppliers, (6) reduced logistical costs (Bozarth *et al.* 1998), (7) coordinated replenishment (Russell and Krajewski 1992), (8) improved buyer–supplier product design relationship (De Toni and Nassimbeni 1999), (9) improved trust due to communication (Newman 1988a), (10) improved performance (Shin *et al.* 2000) and (11) better customer service and market penetration (St. John and Heriot 1993). The benefits attributed to this practice often exceed those achieved through traditional bidding from multiple sources, which often emphasizes low price at the expense of performance (Mohr and Spekman 1994). Moreover, supply base consolidation sets the stage for future development of the chosen suppliers (Handfield 1993). In practice, a significant shift has occurred from traditional multiple sourcing, characterized by adversarial buyer–seller relationships, to the use of a limited number of qualified suppliers (Morgan 1987, Raia 1988, 1993, Burt 1989, Helper 1991, Offodile and Arrington 1992). This appears to be consistent with the notion of parallel sourcing, which involves the use of multiple sole sources for each type of component that provides incentives for supplier performance associated with multiple sourcing while preserving claimed benefits of sole sourcing (Richardson 1993).

### 2.2.3. Long-term relationships

Though longer planning horizon have become a crucial characteristic of modern supply chain relationship (Shin *et al.* 2000), long-term relationships does not refer to any specific period of time, but rather, to the intention that the arrangement is not going to be temporary. Through close relationships supply chain partners are willing to (1) share risks and reward and (2) maintain the relationship over a longer period of time (Landeros and Monczka 1989, Cooper and Ellram 1993, Stuart 1993). Hahn *et al.* (1983) compared the potential costs associated with different sourcing strategies and suggested that companies would gain benefits by placing a larger volume of business with fewer suppliers using long-term contracts. Moreover, De Toni and Nassimbeni (1999) found that a long-term perspective between the buyer and supplier increases the intensity of buyer–supplier coordination. Carr and Pearson (1999) discovered that strategically managed long-term relationships with key suppliers have a positive impact on a firm's supplier performance. Through a long-term relationship, the supplier will become part of a well-managed chain and will have a lasting effect on the competitiveness of the entire supply chain (Choi and Hartley 1996, Kotabe *et al.* 2003).

Supplier contracts have increasingly become long-term, and more and more suppliers must provide customers with information of their processes, quality performance, and even cost structure (Helper 1991, Helper and Sako 1995). Closer and long-term relationships with suppliers are evident in several industries (e.g. Hakansson 1987, Lorenzoni and Ornati 1988, Womack *et al.* 1991, Lamming 1993, Nishiguchi 1994), which cause increasing dependence on suppliers (Sabel *et al.* 1987, Slack 1991, Christopher 1992). The terms 'partnership' and 'partnership sourcing' have been used to refer to these closer, longer relationships with suppliers

(Johnston and Lawrence 1990, Hines 1994, Macbeth and Ferguson 1994). These long-term orientations support most recent findings, which discover that once transactors have made the up-front investment to develop self-enforcing safeguards such as relational trust, the transaction costs decline in the long term because self-enforcing safeguards can control opportunism over an indefinite time horizon (Dyer 1997). Specifically, the transaction costs and inventory holding costs associated with arm's-length bidding practices, characterized by short-term relationships with a large number of short-term suppliers, can actually outweigh the costs of the parts themselves (Dyer 2000).

#### 2.2.4. *Supplier selection*

Selecting suppliers for specific goods and services is a critical decision for most organizations, since supply performance can have a direct financial and operational impact on the business (Bailey *et al.* 1994, Ittner *et al.* 1999). It has thus been argued that organizations are buying the supplier's capabilities (Croom 1992). *Ceteris paribus*, the formal sourcing protocol relied heavily on the supplier's ability to meet cost targets. In practice, however, a much wider set of concerns are involved (Croom 2001). Dickson (1966) states that the abilities to meet quality standards and deliver products on time as well as performance history are the most critical determinants in choosing suppliers. Thus, quality has always been one of the most important performance criteria even with the conventional purchasing strategy (Dickson 1966, Dempsey 1978, Narasimhan 1983, Willis and Huston 1989, Helper 1991, Weber *et al.* 1991, Choi and Hartley 1996). Many conceptual studies also emphasize that supply management must have a quality focus (Manoocheri 1984, Treleven 1987, Baxter *et al.* 1989). Helper (1991) showed that the importance of quality criteria has increased the most while the importance of price increased the least during the period. Choi and Hartley (1996) also found that companies place more importance on consistency (quality and delivery) and the least importance on price. On the whole, quality, on-time delivery, and uninterrupted supply become critical selection criteria because supplier failures on these dimensions have more serious adverse effects on the buyer's operations (Ellram 1990). Trustworthiness, integrity, commitment, and characteristics that imply 'fair dealing' are also considered with importance in selecting the supplier (Anderson and Narus 1990, Lewis 1995). Specifically, suppliers who are unwilling to share information on cost, quality and production can be screened out, because willingness to share information is viewed as a signal of the trustworthiness of the supplier (Dyer 1997).

#### 2.2.5. *Supplier certification*

According to Murphy (1992), supplier quality begins with supplier certification. Supplier certification involves the thorough examination of all aspects of a vendor's performance and is expected to enhance buyer-supplier trust and communication, to improve supplier product quality, to reduce communication errors, and to reduce inspection and inventory costs for the buyer (Inman and Hubler 1992, Jancsurak 1992, Lockhart and Ettkin 1993, Schneider *et al.* 1995, Larson and Kulchitsky 1998, Ittner *et al.* 1999). Baiman *et al.* (1998) described a certified supplier as a vendor who, after extensive investigation of its manufacturing operations, production capabilities, personnel and technology, is certified to provide materials and components without routine testing of each receipt. Grieco (1989) depicted supplier certification as a buyer-supplier partnership, involving higher levels of trust and communication,

leading to improved quality and lower costs. Recently, supplier certification has been extended to include the logistics function. Gibson *et al.* (1995) illustrated the utilization of supplier certification to certify carriers and its benefits. Inman and Hubler (1992) carried the concept of supplier certification further by suggesting that manufacturers should consider certification of supplier's product as well as its processes. Maass *et al.* (1990) contended that a small group of organizations even encourage suppliers to pursue self-certification. American Quality Foundation and Ernst and Young (1998), in their international quality study of over 500 organizations, reported that formal programs for certifying suppliers showed an across-the-board beneficial impact on performance, especially in quality and productivity. Researchers also conclude that supplier certification supports greater joint action between buyer and supplier by providing a mechanism for screening a supplier's motivation and capabilities (Heide and John 1990, Carr and Ittner 1992, Ellram and Siferd 1998).

#### 2.2.6. *Supplier involvement*

A considerable amount has been written documenting the integration of suppliers in the new product development process (Burt and Soukup 1985, Clark and Fujimoto 1991, Helper 1991, Hakansson and Eriksson 1993, Lamming 1993, Hines 1994, Ragatz *et al.* 1997, Dowlatshahi 1998, 2000, Swink 1999, Shin *et al.* 2000). The involvement may range from giving minor design suggestions to being responsible for the complete development, design and engineering of a specific part of assembly (Wynstra and Pierick 2000, Wynstra *et al.* 2000). This practice can be attributed to the fact that suppliers accounted for approximately 30% of the quality problems and 80% of product lead-time problems (Naumann and Reck 1982, Burton 1988). Aleo (1992) discussed Kodak's early supplier involvement program that involved suppliers in its new R&D efforts. Cayer (1988) discussed Motorola's strategy to include suppliers in the early developmental stages of new products to benefit from their technical expertise. Clark (1989) and Clark and Fujimoto (1991) elaborated on the use of suppliers by Japanese manufacturers in the new product development process and the potential benefits of such supplier involvement. Kamath and Liker (1994) also examined Japanese product development practices and identified a variety of roles that suppliers may play. Mabert *et al.* (1992) found supplier involvement to be an important part of the strategy in five out of the six firms they examined who were attempting to collapse new product development time. Birou and Fawcett (1994) compared the experiences of US and European manufacturers with supplier integration into product development. Eisenhardt and Tabrizi (1994) looked at supplier involvement as one key factor in reducing product development times in the computer industry. LaBahn and Krapfel (1994) examined factors that affect supplier interest in early involvement in new product development. Furthermore, research has concluded that the effective integration of suppliers into new product development can yield such benefits as reduced cost and improved quality of purchased materials, reduced product development time, and improved access to and application of technology (Ragatz *et al.* 1997, 2002, Primo and Amundson 2002).

#### 2.2.7. *Cross-functional teams*

Managing long-term relationships with customers using cross-functional teams is becoming a common practice in supply chains (Smith and Barclay 1993, Moon and Armstrong 1994, Deeter-Schmelz and Ramsey 1995, Narus and Anderson 1995,

Helfert and Vith 1999). Teamwork is a critical component of many organizational change efforts in the 1990s. The breadth of corporate objectives pursued through teamwork indicates that it is central to many attempts at wide-ranging organizational transformation (Drew and Coulson-Thomas 1997). Organizations achieving transformation through increased customer focus anticipate quite dramatic increases in team-based effort. Firms changing their value chain and supplier relations also anticipate major contributions through team effort. The greatest changes are those areas of the firm that interact with outsiders: customers, suppliers and international partners (Handy 1990, Davidow and Malone 1992, Hastings 1993).

Cross-functional teams have been identified as important contributors to the success of such efforts as supplier selection, product design (Burt 1989), just-in-time manufacturing, cost reduction, total quality initiatives (Burt and Doyle 1993, Ellram and Pearson 1993) and, most of all, improved communication. Because of the wide range of supplier problems, potentially addressed by better buyer–supplier relationships, expertise is required from various functions (Hines 1994, Narus and Anderson 1995, Krause and Elram 1997, Helfert and Gemunden 1998).

#### 2.2.8. *Trust and commitment*

Cooperation, whereby firms exchange bits of essential information and engage some suppliers–customers in longer-term contracts, has become the threshold level of supply chain interaction (Spekman *et al.* 1998). SCM is built on a foundation of trust and commitment (Lee and Billington 1992, Kumar 1996). The consensus is that trust can contribute significantly to the long-term stability of an organization (Heide and John 1990, Handfield and Bechtel 2002). Trust is conveyed through faith, reliance, belief or confidence in the supply partner and is viewed as willingness to forego opportunistic behaviour. Trust is one's belief that one's supply chain partner will act in a consistent manner and do what he/she promises. It is the sense of performance in accordance with intentions and expectations that hold in check one's fear of self-serving behaviour on the part of the other members of the supply chain (Nooteboom *et al.* 1997). Commitment implies that the trading partners are willing to devote energy to sustaining this relationship (Dion *et al.* 1992). That is, committed partners dedicate resources to sustaining and furthering the goals of the supply chain. To a large degree, commitment makes it more difficult for partners to act in ways that might adversely affect overall supply chain performance. With commitment, supply chain partners become integrated into their major customers' processes and more tied to their goals.

While trust comes in various forms such as 'cognitive trust' and 'calculative trust', it is the calculative trust that can have a significant impact on buyer–supplier relationships and, consequently, supply chain performance. For example, Hill (1990) argues that contrary to the theory of transaction cost economics (TCE) that opportunism generally characterizes exchange, relationships based on cooperation and trust are more likely to survive in the marketplace. Therefore, it is argued that the assumption that opportunism characterizes exchange should be reconsidered in favour of one that suggests that trust characterizes exchange (Zaheer and Venkatraman 1995). Specifically, although legal contracts are viewed as the primary means for safeguarding transactions in Western economics, alternative means such as relational trust has proven to be an efficient governance mechanism that reduces transaction costs by minimizing search, contracting, monitoring and enforcement costs over the long term (Dyer 1997). Further, a high level of interorganizational

trust is found to be related to enhanced supplier performance, lowered costs of negotiation and reduced conflict (Zaheer *et al.* 1998).

### 2.3. *Logistics integration*

Logistics provides industrial firms with time and space utilities (Caputo and Mininno 1998). It has traditionally been defined as the process of planning, implementing and controlling the efficient flow and storage of goods, services and related information as they travel from the point of origin to the point of consumption. Some of the activities included in the logistics domain include transportation, warehousing, purchasing and distribution. Within this model, the locus of logistics control has been the individual firm. A more recent interpretation calls for logistics to guarantee that the necessary quantity of goods is in the right place and at the right time (La Londe 1983). The reduction of organizational slack, of which inventory is a typical example, needs close coordination of and an intensive information exchange between the supply chain partners (Caputo 1996, Vollman *et al.* 1997). This current trend in using strategic partnerships and cooperative agreements among firms forces the logistics integration to extend outside the boundaries of the individual firm (Langley and Holcomb 1992).

The traditional approach of logistics integration across functional boundaries within a firm is termed 'internal integration' (Bowersox and Daugherty 1987), whereas a more recent approach of logistics integration across firm boundaries is termed 'external integration' (McGinnis and Kohn 1990, Stock *et al.* 1998). External integration has been the subject of a good deal of research in logistics management, although it is also known as 'supply chain integration' (Armistead and Mapes 1993, Berry *et al.* 1994, Cooper *et al.* 1997b, Towill 1997), 'enterprise logistics' (Fox 1991, 1992, Wasik 1992, Drew and Smith 1995), and 'integrated logistics' (Stock 1990, Larson 1994, Drew and Smith 1995, Gustin *et al.* 1995, Bowersox 1997). These terms underline the mutual completion of procurement, production planning and distribution in order to carry out a unitary process (La Londe *et al.* 1970, Busch 1988, La Londe and Powers 1993). *Enterprise logistics integration* is the extent to which a firm implements both internal and external integration. It can be characterized by integration of logistics activities across functional departments within the firm, as well as integration of the firm's logistics activities with the logistics activities of other supply chain members (Stock *et al.* 1998). This notion of enterprise logistics integration reflects the growing importance of logistics as a coordinating mechanism among multiple units of the enterprise and, ultimately, as a source of customer value and competitive advantage. Literature contributing to SCM from the perspective of logistics integration is also highlighted in table 1.

#### 2.3.1. *Internal integration*

Internal integration is the degree to which firms are able to integrate and collaborate across traditional functional boundaries to provide better customer service (Kingman-Brundage *et al.* 1995, Cespedes 1996, Kahn and Mentzer 1996). Stolle (1967) pointed out that managing logistical activity involves other functions within the firm, namely marketing, finance, purchasing, and production. Coordination is required within the firm's internal supply chain departments to realize the desired benefits for the firm (Ballou *et al.* 2000). It is widely agreed that task interdependence is the catalyst for interdepartmental integration (Ellinger 2000). In simpler terms, customer satisfaction is dependent on the output of more than one worker or

one functional area. Benefits will be realized by companies that operate their logistics processes as an integrated system rather than by optimizing functional subsystems (Kent and Flint 1997). Numerous empirical studies suggest that collaborative cross-functional integration is positively associated with performance (Souder 1987, Griffin and Hauser 1996, Kahn 1996). Collaborative interdepartmental integration involves a predominantly informal process based on trust, mutual respect and information sharing, the joint ownership of decision, and collective responsibility for outcomes (Rinehart *et al.* 1989, Bowersox *et al.* 1992, Moenaert *et al.* 1994, Griffin and Hauser 1996, Kahn 1996, Stank *et al.* 1999). Thus, collaboration between departments is often needed to ensure delivery of high quality services to customers, and involves the ability to work seamlessly across the silos that have characterized organizational structures (Liedtka 1996). Collaborative behaviour is based on cooperation (willingness), rather than on compliance (requirement). Its success is contingent upon the ability of individuals from interdependent departments to build meaningful relationships (Appley and Winder 1977, Tjosvold 1988, Gray 1989, Schrage 1990). Higher levels of internal integration are characterized by increased coordination of logistics activities with other departments in the firm, increased importance of logistics in the overall business strategy, and a blurring of the formal distinction between logistics and other areas of the firm (McGinnis and Kohn 1990).

### 2.3.2. *External integration*

External integration is the integration of logistics activities across firm boundaries. It reflects an extension of manufacturing enterprise to encompass the entire supply chain, not just an individual company, as the competitive unit (Greis and Kasarda 1997). Managers are coordinating with companies beyond their own, seeking new ways to lower costs or improve service through mechanisms such as vendor managed inventory and just-in-time scheduling (Ballou *et al.* 2000). Collaboration is needed across enterprise boundaries interfacing with external suppliers, carrier partners and customers. As such, logistics is in a boundary-spanning role with these external customers as well (Bowersox *et al.* 1988, Bowersox and Closs 1996). Morash *et al.* (1997) identify customer service, quality, channel distribution, and total cost minimization as major boundary-spanning interface capabilities. Although not meant to be exhaustive of logistics capabilities, these concepts are mentioned most often in modern logistics literature and are central to modern logistics thinking (Morash 1990, Stock and Lambert 1992, Lambert and Stock 1993, Christopher 1994). Various external logistics interactions have been examined extensively in prior research (Dolan 1987, Vonderembse *et al.* 1995, Walton and Marucheck 1997). Higher levels of external integration are characterized by increased logistics related communication, greater coordination of the firm's logistics activities with those of its suppliers and customers, and more blurred organizational distinctions between the logistics activities of the firm and those of its suppliers and customers (Stock *et al.* 2000).

### 2.4. *Supply network coordination*

Unlike the empirical research approach to SCM that we have reviewed in the previous sections, there have been several literature survey articles that focus on the mathematical modelling approach to SCM. As such, we chose not to review the research base that attempts to model and optimize supply chain problems, and

instead refer interested readers to the focused reviews written by Thomas and Griffin (1996), Beamon (1998), Erenguc *et al.* (1999), and Sahin and Robinson (2002). The characteristics of the modelling approach including the scope of problems, decision variables, and methodologies, however, will be briefly described here to complete our coverage on diverse streams of SCM research.

A sizeable number of researchers have adopted the mathematical modelling approach in their study of SCM. Under this approach, a common goal is to optimize the planning and coordination of the three fundamental supply chain stages: procurement, production, and distribution. Each of the three stages may be further comprised of multiple facilities in various locations in different countries. It is, thus, understandable that the majority of researchers have opted to model a much narrower scope of supply chain problems, as the three stages may span many functional departments within and across firms and the complexity has made the formulation of supply chain models challenging and the optimal solution problematic, if not impossible. For example, researchers have concentrated on the optimal ordering policies in *buyer-vendor* coordination using economic order quantity (EOQ) and quantity discount inventory models (e.g. Goyal 1988, Lau and Lau 1994). Various forms of *production-inventory-distribution* coordination have also been widely studied, though many problems in these areas, formulated as dynamic programming, integer programming or non-linear programming, are extremely difficult to solve (e.g. Ernst and Pyke 1993, Chandra and Fisher 1994, Lee *et al.* 1997). Not surprisingly, researchers of this approach have spent more energy in developing algorithms and heuristic procedures for the problems they formulated than in understanding what initiatives and activities constitute the new management philosophy of SCM or shaping the notion of SCM.

Most of the supply chain modelling research is an extension or integration of the traditional problems of (1) production planning and inventory control and (2) distribution and logistics. Depending on the scope of supply chain issues researchers chose to address, the decision variables used in their models could include demand variability, production scheduling, inventory levels, number of echelons (stages), distribution centres, manufacturing plants, number of products types, etc. The methodology adopted in the modelling approach is then determined by the decision variables considered and the objective of the study. The supply chain problems are formulated either as deterministic analytical models, if the decision variables are known with certainty, or as stochastic analytical models, when at least one of the decision variables is unknown and is assumed to follow a particular probability distribution. Simulation methods have also been adopted for analysing more complex problem settings that include a larger number of decision variables where optimal solutions may not be possible.

Apart from the growing stream of supply chain optimization models, the study of the 'bullwhip effect' is a noticeable contribution of the modelling approach in providing additional insights into supply chain dynamics. Anchored on Forrester's visionary work (Forrester 1958, 1961), Lee *et al.* (1997) refines the supply chain's natural tendency to amplify, delay, and oscillate demand information, and demonstrates that rational independent decision-making, increased order lead-time, and simultaneous ordering by retailers increase demand amplification. While many more studies have explored the causes of the bullwhip effects, the magnitude of bullwhip effects reduction through information sharing and physical coordination is still not well understood.

The mathematical modelling approach is excellent in providing insight and understanding in well-defined supply chain settings involving few decision variables and highly restrictive assumptions. This approach is, however, deficient when applied to more realistic and, thus, more complex supply chain situations. Therefore, the result of much supply chain modelling research is mathematical rigor that suffers from unrealistic assumptions and lack of generality. It should also be noted that most principles behind the mathematical models are shaped by the empirical studies in (1) strategic purchasing, (2) supply management and (3) logistics integration elaborated above.

### 3. Supply chain performance

An effective performance measurement is essential for SCM because it (1) provides the basis to understand the system, (2) influences behaviour throughout the system and (3) provides information about the results of system efforts to supply chain members and outside stakeholders (Fawcett and Clinton 1996). Furthermore, researchers have found that measuring supply chain performance in and of itself leads to improvements in overall performance (Bello and Gilliland 1997). The treatment of performance in research settings, however, is perhaps one of the thorniest issues confronting academic research today (Neely 1998) because of debates about issues of terminology, level of analysis (i.e. individual, work unit, or organization as a whole), and conceptual bases for assessment of performance (Ford and Schellenberg 1982). Research efforts on supply chain performance are summarized in table 1.

#### 3.1. Financial performance

A common measure of business performance is referred to as the financial performance because it centres on the use of simple outcome-based financial indicators that are assumed to reflect the fulfilment of the economic goals of the firm. Financial performance has been the dominant model in empirical strategy research (Hofer 1983, Venkatraman and Ramanujam 1987). Typical of this approach would be to examine such indicators as sales growth, profitability, earnings per share, and so forth. The inadequacies of using solely financial performance measures in manufacturing and supply chains, however, have been well documented in the academic literature (Skinner 1971, Hall 1983, Johnson and Kaplan 1987, Dixon *et al.* 1990, Geanuracos and Meiklejohn 1993, Chen and Lee 1995, Medori *et al.* 1995, Neely *et al.* 1995, Neely 1998, Beamon 1999). It has been further argued that every manager knows that there are important limitations in relying exclusively on financial measures of performance (Eccles and Pyburn 1992). These traditional measures are at best too summarized to be useful and, at worst, they provide a very limited and often misleading picture of organization's performance (Tarr 1995). Kaplan (1988) contended that companies have relied on summary financial measures and thus ignored the powerful opportunities for continuous improvement that a well-constructed set of non-financial operating measures can offer.

#### 3.2. Operational performance

A broader conceptualization and more effective business performance should include indicators of operational performance in addition to those of financial performance. This is mainly because non-financial measures can overcome the limitations of just using financial performance measures (Eccles and Pyburn 1992,

Medori *et al.* 1995, Neely 1998, Beamon 1999, Medori and Steeple 2000). There are many advantages of using non-financial measures, including the facts that non-financial measures are more timely than financial ones (Chen and Lee 1995), they are more measurable and precise, they are consistent with company goals and strategies, and non-financial measures change and vary over time as market needs change and thus tend to be flexible (Medori and Steeple 2000).

While financial performance measures are more likely to reflect the assessment of a firm by factors outside of the firm's boundaries, operational measures reflect more directly to the efficiency and effectiveness of the operations within the firm. These categories of performance reflect competencies in specific areas of supply chain including cost, delivery speed and reliability, quality, and flexibility. They also mirror the two arguably most important dimensions of supply chain performance: *efficiency*, the ability to provide a service at a lowest possible cost, and *customer service*, the ability to accommodate customers' special requests (Fawcett and Clinton 1996). Operational performance measures provide a relatively direct indication of the efforts of the various supply chain constructs.

### 3.3. *Measuring supply chain performance*

Time-based performance measure, among others, has recently received substantial attention in SCM. For example, researchers have considered different aspects of time-based performance relative to various stages of the overall value delivery cycle and have proposed several measures to evaluate them (Jayaram *et al.* 1999). The key dimensions of time-based performance include delivery speed (Handfield and Pannesi 1992, Vickery *et al.* 1995), new product development time (Vickery *et al.* 1995), delivery reliability/dependability (Handfield 1995, Roth and Miller 1990), new product introduction (Vickery *et al.* 1995, Safizadeh *et al.* 1996) and manufacturing lead-time (Handfield and Pannesi 1995). In addition, customer responsiveness has also been recognized in the agility literature as a key aspect of time-based performance (Hendrick 1994). Rapid confirmation of orders and rapid handling of customer complaints are found to be two key indicators of customer responsiveness (Stalk and Hout 1990, Tunc and Gupta 1993, Tersine and Hummingbird 1995).

To address supply chain performance from a more systematic perspective, several new frameworks have recently been proposed. For example, Beamon (1999) argues that any supply chain measurement system must involve three types of performance measures: resource measures (generally cost), output measures (generally customer responsiveness), and flexibility measures. In what is called a balanced approach, Gunasekaran *et al.* (2001) presented a long list of key supply chain performance metrics, classified at strategic, tactical, and operational levels. These metrics are further designated financial and non-financial measures. While the list appears to be comprehensive, duplication and overlapping is an issue. For example, both 'delivery lead time' and 'delivery performance' metrics are included in the strategic level. Moreover, the designation of each performance metric to the three different levels remains questionable.

It is clear that a supply chain measurement system that consists of either financial or operational measures alone is generally inadequate. Moreover, as we reviewed above, most studies have adopted financial and/or operational measurements to gauge the improvement and performance of the focal firm (i.e. either buyer or supplier). The notion of SCM, however, entails measuring the performance of the entire supply chain rather than just the performance of the individual supply chain

partners. After all, the essence of SCM implies that it is the combined performance of the integrated supply chain that is of paramount importance. It is encouraging to note that several researchers have started to propose measurement of overall supply chain performance including assessing (1) the extent to which supply chain relationships are based on mutual trust, (2) changes in average volume of inventory held and frequency of inventory turnover across supply chain over time and (3) the adaptability of the supply chain as a whole to meet changing customer needs (Fawcett and Clinton 1996, Bello and Gilliland 1997). In their seminal work, Kaplan and Norton (1996a, b) also proposed a 'balanced scorecard' approach for supply chain performance measurement. Their approach incorporates both financial and operational performance measures that are used at various levels of the supply chain including supply chain, organizational, functional, and team levels. There is an opportunity as well as a challenge for researchers to develop new performance measures for the entire supply chain that would be stimulants for improved supply chain practice.

#### 4. Theoretical research framework

SCM, as we envision, is a novel management philosophy that recognizes that individual businesses no longer compete as solely autonomous units, but rather as supply chains. Therefore, it is an integrated approach to the planning and control of materials, services and information flows that adds value for customers through collaborative relationships among supply chain members. The framework in figure 2 depicts our conceptualization of SCM.

Grounded on a paradigm of strategic management theory emphasizing the development of *collaborative advantage* (e.g. Contractor and Lorange 1988, Nielsen 1988, Kanter 1994, Dyer and Singh 1998, Dyer 2000), this framework underscores our premise that a supply chain is composed of a network of interdependent relationships developed and fostered through strategic collaboration with the goal of deriving mutual benefits (Miles and Snow 1986, Thorelli 1986, Borys and Jemison 1989, Lado *et al.* 1997, Ahuja 2000). This framework also draws on the innovative *relational view* of interorganizational competitive advantage (Dyer and Singh 1998, Lorenzoni and Lipparini 1999, Kale *et al.* 2000), in contrast to the *resource-based view* (RBV) of the firm (e.g. Barney 1991, Teece *et al.* 1997). Although complementary to the RBV, the relational view considers the dyad/network instead of individual firms as the unit of analysis and, thus, provides a more coherent support of our view of SCM.

This framework is developed to guide research efforts and provide insights for managerial practice. To help better understand the framework and the intricacies in relations among the key supply chain initiatives and activities discussed in this paper, the theoretical support for the framework is briefly offered below. Since it is not developed as a research model and due to space limitation, a detailed analysis of relevant literature is omitted. Readers interested in developing empirically testable research models are referred to the selected literature reviewed in the previous sections.

##### 4.1. *Driving forces*

As shown in figure 2, environmental uncertainty, customer focus and information technology are the three key external driving forces instrumental to the development of the notion of SCM. The uncertainty that plagues supply chains can be attributed to three sources: *supplier* uncertainty, arising from on-time perfor-

mance, average lateness, and degree of inconsistency; *manufacturing* uncertainty, arising from process performance, machine breakdown, supply chain performance, etc.; and *customer/demand* uncertainty, arising from forecasting errors, irregular orders, etc. (Davis 1993). Under conditions of increased uncertainty and the lack of other alternatives, organizations in the value chain are more likely to engage in collective actions in order to stabilize their environment.

The pressure to revitalize manufacturing over the past few decades has been rooted in customers' demand for a greater variety of reliable products with short lead-time. The more attention a company pays to researching its customer base to identify customer needs, the more rewarding the exchange transaction in supply chain will be for the company (Carson *et al.* 1998). Since customer expectations are dynamic in nature, an organization needs to reassess them regularly to align and refine their customer focus and adjust its supply chain strategy accordingly (Takeuchi and Quelch 1983, Shepetuk 1991).

Research has revealed information technology as an effective means of promoting collaboration between collections of firms, such as groups of suppliers and customers organized into networks. More than ever before, today's information technology is permeating the supply chain at every point, transforming the way exchange-related activities are performed and the nature of the linkages between them (Palmer and Griffith 1998). Information technology is found to enhance supply chain efficiency by providing real-time information regarding product availability, inventory level, shipment status, and production requirements (Radstaak and Ketelaar 1998). It also has vast potential to facilitate collaborative planning among supply chain partners by sharing information on demand forecasts and production schedules that dictate supply chain activities (Karoway 1997). Furthermore, information technology can effectively link customer demand information to upstream supply chain functions and subsequently 'pull' (demand-driven) supply chain operations (Min and Galle 1999).

#### 4.2. *Strategic purchasing and other supply chain initiatives*

Numerous studies point out that the importance of supply management has grown in prominence since purchasing has become more strategic in nature (Burt and Soukup 1985, Cousins 1992, Lamming 1993, Ellram and Carr 1994, Nishigushi 1994, Carr and Pearson 1999). Carr and Smeltzer (1999) have shown that firms with strategic purchasing are more likely to be able to impact *communication*, cooperative relationships, and the responsiveness of suppliers. Kraljic (1983) notes that strategic purchasing focus is critical for communication throughout the supply chain. More specifically, it has been found that information sources are related to the buyer's strategic behaviour (Spekman *et al.* 1995). Furthermore, Cox (1996) has presented a model of procurement management that emphasizes the importance of strategic purchasing and relationships communication.

Strategic purchasing is considered pertinent to *supply base reduction* since the latter compromises the leveraging ability of the buying firms and, therefore requires a totally different management style (Cousins 1999). Many firms with strategic purchasing focus are reducing the number of primary suppliers and allocating a majority of the purchased material to a single source (Manoocheri 1984, Hahn *et al.* 1986, Spekman 1988, Pilling and Zhang 1992, Kekre *et al.* 1995). Strategic purchasing also has a proactive and long-term focus (Pearson *et al.* 1996). Firms that conduct long-term planning and consider purchasing to be strategic are more likely to build *long-*

*term cooperation relationships* with their key suppliers (Carr and Pearson 1999). A cooperative or close relationship refers to the process of working together, over an extended period of time, for the benefit of both firms (Landeros and Monczka 1989, Cooper and Ellram 1993). Moreover, a short-term oriented adversarial buyer–supplier relationship is not consistent with the long-term corporate level strategic planning (Watts *et al.* 1992).

As suppliers have a lasting effect on the performance of the entire supply chain, one of the fundamental responsibilities of the purchasing functions is the appropriate selection of suppliers (Mandal and Deshmukh 1994, Choi and Hartley 1996, Carr and Pearson 1999). The *supplier selection* decision affects activities such as inventory management, production planning and control, and product quality (Narasimhan 1983). Traditional sourcing protocol relied heavily on the supplier's ability to meet cost targets. Other criteria, such as quality, on-time delivery, and uninterrupted supply, however, have become increasingly critical because supplier's failures on these dimensions have more serious adverse effects on the buyer's operations (Ellram 1990). Therefore, the nature of supplier selection decision made by the purchasing function is now more strategic and based on long-term criteria rather than cost-based alone (Watts and Hahn 1993).

*Supplier certification* involves higher levels of trust and communication and leads to improved quality and lower costs (Grieco 1989). Strategic purchasing function is responsible for positively motivating as well as evaluating suppliers for maximum performance (Browning *et al.* 1983, Giunipero 1990). Supplier certification supports greater joint action between buyer and supplier by providing a mechanism for screening a supplier's motivation and capabilities (Carr and Ittner 1992, Ellram and Siferd 1998). Therefore, it is expected that as the strategic nature of the purchasing function increases, more sophisticated supplier certification procedures will be developed and practised (Monczka and Morgan 1992).

*Supplier involvement* is a critical element of strategic buyer–supplier relationship because many researchers have demonstrated that supplier involvement can provide multiple benefits such as reduced cost and improved quality of purchased materials, reduced product development time, and improved access to and application of technology (Ragatz *et al.* 1997, 2002, Swink 1999, Shin *et al.* 2000, Primo and Amundson 2002). Since one of the primary goals of the purchasing function is recognizing or creating sources of competitive advantage, and improving new product development processes is an important source of competitive advantage (Capon *et al.* 1990, Droge *et al.* 1994), enhanced supplier integration through strategic purchasing is expected to improve firm's performance in new product development and other strategic initiatives.

*Cross-functional teams* contribute to the success of supplier selection, product design (Burt 1989), total quality initiatives (Burt and Doyle 1993, Ellram and Pearson 1993), and improvised communication. Moreover, cross-functional teams have been proved very effective in meeting the challenges of successful supplier integration for new product development (Ragatz *et al.* 1997). Therefore, due to its wide-ranging benefits, strategic purchasing is believed to promote an increased usage of cross-functional teams.

SCM is built on a foundation of *trust and commitment* (Lee and Billington 1992, Kumar 1996). Trust contributes significantly to the long-term stability of the buyer–supplier relationship (Handfield and Bechtel 2002). Committed partners also dedicate resources to sustaining and furthering the goals of this relationship.

Thus, buyer–supplier relationships enforced by strategic purchasing and based on trust and commitment foster sharing of information ranging from R&D to product design and production plan. With higher levels of trust and commitment, relationship partners share a common vision of the future, recognizing that their long-term success is only as strong as their weakest supply chain link.

Researchers also note that the strategic nature of purchasing reflects its integrative role (Freeman and Cavinato 1990, Gadde and Hakansson 1993, Ellram and Carr 1994). The conceptual re-description of purchasing as integration of internal and external exchange functions, therefore, illustrates that it is conducive and instrumental to *supply network coordination* and enterprise-wide *logistics integration*. Similar to the three SCM external driving forces, strategic purchasing serves as an internal driving force for supply management.

#### 4.3. *Supply chain initiatives and supply chain performance*

It is evident from prior research that superior buyer–supplier relationships lead to improved performance of both supplier and buyer. For example, *supply base reduction* has been found to provide multiple benefits including better time-based and cost-based performance (Russell and Krajewski 1992, Kekre *et al.* 1995, Bozarth *et al.* 1998, De Toni and Nassimbeni 1999, Shin *et al.* 2000). Studies have illustrated that higher levels of trust and commitment evident in *long-term relationships* improve the firms' performance (Noordewier *et al.* 1990, Jones *et al.* 1997, Handfield and Nichols 1999, Hoyt and Huq 2000). Numerous articles also point to the importance of *communication* in the elimination of waste as well as in the improvement of supplier's performance (e.g. Lamming 1996, Krause and Ellram 1997, Lengnick-Hall 1998, Krause 1999, Lewis 2000). *Cross-functional teams* have been identified as important contributors to the success of *supplier selection* (Burt 1989) and supply chain performance (Burt and Doyle 1993, Ellram and Pearson 1993). *Supplier involvement* has also been found to provide multiple benefits such as reduced cost and improved quality of purchased materials, reduced product development time, and improved access to and application of technology (e.g. Bonaccorsi and Lipparini 1994, Ragatz *et al.* 1997, 2002, Swink 1999, Shin *et al.* 2000, Primo and Amundson 2002).

In addition, supplier performance is a key determinant of a buying firm's competitiveness (Noordewier *et al.* 1990). Extant research has also demonstrated that supplier performance is one of the determining factors for the company's operational performance (Baxter *et al.* 1989, Davis 1993). Thus, this framework suggests a mediating role of supplier performance in facilitating the link between strategic purchasing guided supply management and buyer performance.

## 5. Conclusion

The growing importance of SCM has engendered a myriad of disjointed research dispersed across many disciplines. In this paper, we have synthesized the large and fragmented body of knowledge into three streams of approach including (1) strategic purchasing/supply management, (2) logistics integration and (3) supply network coordination.

Based on our careful assessment, it has become clear that most supply chain literature has focused on the importance of one or a limited few elements of supply chains. Consequently, it should be noted that understanding the true dynamics of SCM is far more complex than most of these studies have shown.

Our review should convince readers that both academic researchers and practitioners are far from mastering SCM. In fact, some authors have recently asserted that while SCM is a sound concept, turning idea into practice is by no means an easy task and, thus, it has so far received more lip service than accomplishment, except in a few leading-edge companies (Leenders *et al.* 2002). The complex network of interrelated activities in supply chains makes it challenging for managers to describe and comprehend how those activities are related and how they influence each other.

The scientific development of a coherent SCM discipline requires advancements in the development of theoretical models to further enhance our understanding of supply chain phenomena. Our analysis confirms that the area is devoid of clear theory. In particular, the relative importance and interrelationships of various supply chain initiatives and constructs as well as the direct or mediating effects of these activities and constructs on supply chain performance have been hardly explored and, thus, are not well understood. The research framework proposed in this study provides a well-grounded and robust basis for theoretical development of alternative models, allowing researchers to test the validity of and relationships among the various supply chain initiatives along with their impact on supply chain performance, and ultimately to create a coherent theory of SCM.

In addition, readers will not fail to notice that most of the literature on supply chain performance is often limited to a particular aspect of performance measures (e.g. financial or operational), and those who consider multiple aspects frequently focus on the performance of only the focal firm (i.e. buyer or supplier). It is hoped that future research efforts will investigate this profoundly complex and yet extremely important issue, attending to the complexity brought about by the large number of related and interdependent supply chain activities, compounded by the fact that the effects of certain actions are separated from their cause both in time and place.

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