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# A TAXONOMY OF SUPPLY CHAIN COLLABORATION

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## Abstract

*Supply chain collaboration has emerged as an important cooperative strategy leading to new focus on interorganisational boundaries as the determinants of performance. Although collaboration increasingly receives great attention both from practitioners and academics, relatively little attention has been given to systematically reviewing the research literature that has appeared about supply chain collaboration. The purpose of this paper is to examine previous studies on supply chain collaboration based on a taxonomy. The proposed taxonomy is composed of four different research streams of describing specific subjects of interorganisational settings, namely information sharing, business processes, incentive schemes, and performance systems. The analysis includes the assessment of research ideas and key findings. Results show the great variability of key concepts across the four components of the taxonomy and an increased awareness of complementarity amongst research streams. Several recommendations for future research are also identified in this paper.*

*Keywords: supply chain collaboration, literature review, supply chain management, taxonomy*

## Introduction

The productivity levels of collaborative firms are setting new standards of performance worldwide (Spekman *et al*., 1998). Collaboration with downstream and upstream members that coordinates decisions across purchasing, transportation, and inventory management provides a considerable opportunity to the company to increase profits and reduce costs (Harrison and Van Hoek, 2002; Stewart, 1995). For example, while most firms in the discount retail industry have struggled to survive because of fierce competition, high operating costs, and shrinking net profit margins, Wal-Mart has been massively successful by earning normal economic profits. One important reason for its competitiveness is collaboration with its main suppliers, which emphasises synergistic problem solving to provide better value to customers (Kumar, 1996; Parks, 2001).

Supply chain collaboration shifts the focus of understanding supply chain management away from simply looking at internal processes, within the four walls of the individual company, to how the chain members coordinate their efforts across several segments of the supply chain (Harland, 1996; Simatupang and Sridharan, 2002; Spekman *et al*., 1998). Although the term supply chain collaboration appeared with the instigation of time-based competition in the mid-1980s (Blackburn, 1991), there has been relatively little research that investigates the state of the art. Observations are drawn primarily from previous research on supply chain collaboration that mostly focuses its attention on one specific area of collaboration such as information sharing or operational improvements (Blackburn, 1991; Fisher, 1997; Lee *et al*., 1997). Little attention has been given to explaining the progress of supply chain collaboration and to providing the answer to the question of how to integrate different types of collaborative foci. For example, Hammer and Champy (1993) highlighted the importance of business reengineering across boundaries such as between Wal-Mart and Procter & Gamble. The emphasis is on restructuring the entire process of order fulfilment by taking advantage of information technology to enhance decision-making capabilities throughout the supply chain. However, this research stream has paid little attention to the question of how to restructuring rewards and punishments.

There is also a large gap of perspective between academics and practitioners about the term “collaboration”. This is evidenced by the number of synonyms used to describe collaboration such as partnership, alliance, cooperation, interenterprise relationships, and extended enterprise (Lemke *et al*., 2003; Thoben and Jagdev, 2001; Trienekens and Beulens, 2001). A literature review will, therefore, benefit both parties. Academics will receive recent feedback about the state of the art in research methods and design variables in studying supply chain collaboration, whereas practitioners will obtain helpful explanations about the current progress of supply chain collaboration.

The purpose of this paper is to provide a framework within which to understand the recent literature on supply chain collaboration. Since the critical phase in scientific progress is the examination of the state of the art, it is argued that the progress of supply chain collaboration needs to be reviewed to account for different foci that shape the practice of supply chain collaboration. The analysis proceeds based on a taxonomy that aims to identify and highlight four research streams of supply chain collaboration that have recently emerged in the literature (Hart, 1998). The four research streams are information sharing systems, collaborative business processes, collaborative incentive schemes, and collaborative performance systems. Each stream focuses on specific enablers such as instruments or devices that can be used to influence the participating members to exert productive behaviour of attaining overall performance. Results of the review show a great variability of key concepts across the four streams of the taxonomy and increased attention is given to achieving complementarities amongst research streams. Directions for future research are also identified both at the levels of conceptualisation and empirical work on supply chain collaboration.

The reminder of the paper is organised as follows. The next section discusses prior research reviews related to supply chain collaboration. Subsequently, the method section presents the approach taken in this study, a taxonomy of research areas in supply chain collaboration, and data collection. Findings are then presented to show the assessment of ideas and key findings. The next part of this paper discusses the attempt of previous research to employee complementarities between the four areas of collaboration and outlines several recommendations for future research. The paper closes with a consideration of key concepts of this current research.

**Prior research reviews**

This section discusses prior reviews of supply chain collaboration, and aims to provide evidence as to the paucity of review study on supply chain collaboration. The presentation starts with definitions of collaboration and closes with emergent research on supply chain collaboration.

Within the discipline of supply chain management, diverse literature has appeared to examine supply chain collaboration. According to Bowersox (1990), supply chain management can be seen as a collaborative-based strategy to link cross-enterprise business operations in order to achieve a shared vision of market opportunity. Simatupang and Sridharan (2002) contend that supply chain collaboration is often defined as two or more companies working together to create higher profits through defining and delivering products to end customers than can be achieved by acting alone. Similarly, Blackburn (1991) argues that supply chain collaboration makes it easy for different companies along the supply chain to effectively meet end customer needs with minimum costs. Fisher (1997) supports the idea of matching supply and demand at the right time and in the right place as the main role of collaboration between interdependent companies along the supply chain. Based on this discussion, supply chain collaboration can be defined as a means for two or more companies to establish joint efforts in defining and delivering products to end customers that lead to better revenues and lower costs. This implies that the chain members are willing to devise mutual goals and engage in joint efforts that result in better performance for all parties.

Diverse literature on supply chain collaboration has developed into several separate bodies of knowledge. However, relatively little attention has been given to interschool reference. Lamming (1993) reviewed literature about technological innovation and strategic collaboration in an attempt to analyse supplier relationships in the automotive industry. The main argument of Lamming's study is that buyer-supplier relations under lean supply go beyond Japanese-style partnerships because they are based on collaboration between truly equal partners. However, this study exclusively suggests the importance of cost transparency and the sharing of costs-related information between customer and supplier which allows them to work together to reduce costs and make continuous process improvements (Berry *et al*., 1997). In a similar vein, Lowson (2001) proposes an empirical taxonomy of the operational strategies based on the pattern of organisation and structure. The taxonomy is solely concerned with how both retailers and their suppliers can create flexible and responsive solutions to the requirement of mass customisation in fast-moving consumer goods sectors.

Other review papers also put less emphasis on how the chain members distinguish different types of research areas. Thomas and Griffin (1996) review models in the literature associated with coordinated planning between two or more stages of the supply chain and seek to provide models for a total supply chain solution. While such models proved invaluable in improving the understanding of supply chain collaboration, they have not enabled the chain members to identify other streams such as information systems and the costing methods involved in collaboration. To fill this gap, Sahin and Robinson (2002) review literature on supply chain collaboration by combining the two dimensions of information sharing and flow coordination, but they put less emphasis on incentive and performance concerns. Similarly, Min and Zhou (2002) emphasise a review on modelling efforts in supply chain collaboration including an aspect of information technology.

Croom *et al*. (2000) classify the literature of supply chain management based on two criteria: a content- and a methodology-oriented criterion. Although they provide a critical analysis based on different levels within the total network (i.e., dyadic, chain, and network) and different elements of exchange (i.e., assets, information, knowledge, and relationships), little attention has been given to recognising different areas of collaboration. While reviewing literature in multi-stage supply chain modelling which primarily focuses on process optimisation, Beamon (1998) contend that practitioners and academics need to consider evaluation and development of supply chain performance measures. Furthermore, Tsay *et al*. (1999) exclusively deal with research areas in incentive issues such as supply chain contracts. Other previous reviews are more concerned with performance issues in supply chains (e.g., Caplice and Sheffi, 1995; Chow *et al*., 1994; Kleijnen and Smits, 2003).

It is obvious that previous literature reviews on supply chain collaboration are concerned with one or two types of research areas and rarely refer to each other. Scant attention has been given to identifying and integrating the various research streams of the supply chain collaboration topic. Consequently, a new taxonomy is proposed to acknowledge different types of research areas addressed in previous studies. The next section thus attempts to develop a taxonomy that integrates these different research streams.

**Method**

This section provides the approach taken to review previous literature. It begins with the development of a research taxonomy in supply chain collaboration and then closes with data collection and analysis.

The taxonomy proposed in this research provides a framework for locating a particular research focus on supply chain collaboration and thereby enhances the understanding of the use of specific instruments that affect the behaviour of the chain members. In finding the basis for classification (Hart, 1998), a major assumption is the chain members can only be influenced, not directed, to behave toward the attainment of better overall chain performance. Therefore, the chain members are concerned with how to design and implement instruments to motivate productive behaviour that leverages overall performance. According to economic theories, the chain members are most likely to respond to instruments such as incentives (Jensen and Meckling, 1992). The desired behaviour can be encouraged in economic ways, by lowering costs borne- or increasing benefits accrued- by the decision makers when they carry out desired actions. Once such instruments are implemented, they will become accepted norms that govern the chain members' relationships. Accepted norms can be outdated as competition changes over time and thereby outdated instruments need to be identified and redesigned.

New instruments in turn shape new norms for influencing the chain members to attain common objectives (Goldratt, 1990; Simatupang and Sridharan, 2002).

On the basis of the key assumption discussed above, there are two factors that must be considered in developing the taxonomy: interorganisational norms and the nature of the linkage across boundaries (see Figure 1). First, interorganisational norms refer to the extent to which the chain members share acceptable standards or expectations, needed for effective functioning, whilst working with one another. This factor can be sub-categorised into action-oriented and directive-oriented norms. Action-oriented norms indicate how the chain members coordinate their tasks and information exchange. Directive-oriented norms specify how the chain members share acceptable standards for inducing their behaviour to align with the common goal. Second, the nature of the linkage across boundaries has the potential to affect how chain members relate with each other. According to Christopher (1998), the linkage specifies how the chain members define their cross boundaries' contact points to mediate exchange and co-responsibility. This factor can also be sub-categorised into interchange-oriented and responsibility-oriented linkages. Interchange-oriented linkages contend with how the chain members define their cross-boundaries' contact points either as exchange information or incentives. Responsibility-oriented linkages focus on sharing accountability in attaining the goal of collaboration. Combined, these two factors and their four sub-categories project four key attention areas for the creation of devices for influencing the behaviour of supply chain members. These key subject areas are shown in Figure 1.

| | | **Interorganisational Norms** | |
|---|---|---|---|
| | | Action Oriented | Directive Oriented |
| **Nature of Linkage** | Interchange Oriented | 1<br>***Collaborative Information Sharing Systems*** | 3<br>***Collaborative Incentive Schemes*** |
| | Responsibility Oriented | 2<br>***Collaborative Business Processes*** | 4<br>***Collaborative Performance Systems*** |

Figure 1. The taxonomy of research on supply chain collaboration

The four cells can be labelled respectively as: collaborative information sharing systems (cell 1), collaborative business processes (cell 2), collaborative incentive schemes (cell 3), and collaborative performance systems (cell 4). Table 1 shows their differences in terms of key research question, inherent objective, premise, primary task, and examples of main variants.

Table 1. Distinguishing the four research streams of supply chain collaboration

| Distinctive Issues | Research streams | | | |
|---|---|---|---|---|
| | Collaborative Information Systems | Collaborative Business Processes | Collaborative Incentive Schemes | Collaborative Performance Systems |
| Key research question | What information drives the optimisation of total profits? | What processes drive the capture of total profits? | What incentive mechanisms drive productive behaviour? | What performance measurement drives total improvements? |
| Inherent objective | Information visibility and intelligence. | Matching supply and demand through sales. | Incentive compatibility. | Mutual success. |
| Premise | Information is the enabling factor for optimising the supply chain. | Process is the driving factor for matching supply with demand. | Incentive is the inducing factor for aligning behaviour with performance. | Performance is the motivating factor for attaining mutual success. |
| Primary task | Provision of accurate, reliable, timely, and relevant information to decision makers. | Development and implementation of efficient operating and management processes. | Establishment of mechanisms for sharing costs, risks, and benefits. | Establishment of performance metrics, measurement, and evaluation. |
| Examples of main variants | The role of IT and its impact (Byrd and Davidson, 2003; Barut *et al.*, 2002; Hill and Scudder, 2002; Subramaniam and Shaw, 2002), IT solutions (EIS, WMS, ERP, GIS, TIS), information sharing modelling (Keskinocak and Tayur, 200; Lee *et al.*, 1997; Lee and Whang, 2000). | Process redesign (Evans *et al.*, 1995; Hammer and Champy, 1993; Venkatraman, 1994), supply chain design (Fisher, 1997; Van Hoek, 2001), management process (CPFR, QR) (Blackburn, 1991; Barrat and Oliveira, 2001), constraints management (Goldratt *et al.*, 2000). | Performance-based incentives (Corbett *et al.*, 1999; Grout, 1996; Tsay *et al.*, 1999), risk sharing (Billington *et al.*, 2003; Raman, 1998), cost sharing (Kaplan and Narayanan, 2001). | Performance system redesign (Holmberg, 2000; Lambert and Pohlen, 2001), cost management (Cooper and Slagmulder, 1999a), balanced scorecard (Kaplan and Norton, 2002), benchmarking (Polese, 2002; Simatupang and Sridharan, 2004). |

Each research stream represents a different combination of a type of norm and a type of linkage. Collaborative information sharing systems (cell 1) are required while the chain members exercise action-oriented norms and an interchange-oriented linkage. The chain members interact frequently to exchange information that allows them to consider the total picture of the supply chain in making decisions. The focus would be to capture, store, and transmit relevant, timely, and accurate information to decision makers.

When the chain members face action-oriented norms and the responsibility of a shared offering, they need collaborative business processes (cell 2) which represent enabling instruments to effectively match supply and demand at minimal costs. The main task is to minimise supply and demand variations, eliminate wastes, and increase responsiveness along the supply chain. When norms are directive-oriented and the linkage is interchange-oriented, the chain members can use collaborative incentive schemes (cell 3) to encourage each member to share costs, risks, and benefits which result from collaborative efforts. The focus is on finding appropriate mechanisms that tie to overall performance. Finally, when norms are directive-oriented and the linkage is responsibility-oriented (cell 4), the chain members need to design appropriate performance measurements that motivate them to carry out total improvements.

Paralleling the growing amount of research papers on supply chain collaboration, there has been a strong surge of interest in each of the research streams in Figure 1. Researchers have begun to look at each research stream as an important area of inquiry and this deserves serious and sustained attention. Therefore, a number of published works was selected and reviewed to show that - based on the taxonomy - they contribute to advance a specific focus of explaining the supply chain collaboration phenomenon. Suggestions from peer researchers and databases such as Business Source Premier and Emerald were used to trace and find published work on supply chain collaboration. More than eighty published works - relevant to mirroring the content of supply chain collaboration - were selected. Each work was then analysed to locate its appropriate class in the taxonomy. Several iterative discussions with other researchers were carried out to verify the consistency of analysis. This review is not intended to be exhaustive but to map out the diverse body of literature on supply chain collaboration into a workable taxonomy. The next section provides results of the review.

## Results

This section locates and reviews emergent literature according to the taxonomy proposed in the previous section. The results are divided into four subsections. Each subsection discusses selected published works that focus on a particular research stream of collaboration.

### Collaborative Information Sharing Systems

Collaborative information sharing systems make it easy for the chain members to collect, process, store, and disseminate information to support decision-making activities including planning, control, analysis, visualisation, and coordination. Kumar and Van Dissel (1996) argue that a collaborative information system has two different roles: a support role in reducing transaction costs and risks and an enabling role in making the collaboration feasible. Advances in information technology (IT) are causing integrated information systems to become the main enablers of supply chain collaboration by providing the necessary tools that make collaboration feasible. IT can be used to improve market knowledge, response capabilities, and strategy selection (Simchi-Levi *et al*., 2000). Research on this subject attempts to define and design an effective information system that provides the required visibility and intelligence for the chain members to create flexible and responsive supply chain processes. Research variants of this category include the role of IT and its impact, IT solutions, and information sharing modelling.

Empirical studies on the role of IT attempt to examine the extent to which IT enables the participating members to reduce costs, improve productivity, and increase revenues (Barrett and Konsynski, 1982). Today's information and communication technology allows the chain members to collaborate in an innovative way. A retailer in the quick response movement, for instance, tapped IT to capture market information and pass the information from the points-of-sale all the way back along the supply chain to its main suppliers. This enabled them to slash the response time between the appearance of new fashion in the market and product availability at the selling points. Blackburn (1991) provided cases in the U.S. textiles industry where IT-enabled quick response programmes allowed the participating members to reduce markdowns, potential sales lost by out-of-stock, and excess inventory. Hill and Scudder (2002) found that electronic data interchange was used to improve efficiencies rather than to facilitate supply chain integration. Based on the survey, Byrd and Davidson (2003) found a positive relationship between the impact of IT and firm performance.

Companies become more interested in evaluating their investments in supply chain IT because of the considerable money spent in the investment and the rapid changes of IT. Consequently, studies on IT investments have emerged to provide various analysis tools for evaluating and quantifying the feasibility of IT investments. Talluri (2000) suggested a goal programming model for the effective acquisition and justification of supply chain IT. In selecting the right ERP (enterprise resource planning) system, the model considers various factors such as system acquisition and maintenance costs, flexibility, execution accuracy, and compatibility. Barut *et al*. (2002) proposed the degree of supply chain coupling as a measure of the intensity of information sharing about demand, capacity, inventory, and scheduling. Subramaniam and Shaw (2002) proposed a framework for quantifying and measuring the value of B2B e-commerce systems. The model specifies the relationship between four forms of web-based procurement, factors that create value, and factors that affect realised value. The potential of four forms of web-based procurement  buy-side procurement system, private B2B e-market, industry B2B exchange, and third-party B2B market  were identified and analysed in a major heavy-equipment manufacturer. The methodology proposed in this research is originally rooted in the value business model developed by Barua *et al*. (1995), which attempts to link IT drivers, intermediate measures, and financial measures. Various studies in the field of economics also intend to show that IT may reduce the coordination costs of outsourcing activities and therefore stimulate cooperation between firms (Barua *et al*., 1995; Clemons and Kleindorfer, 1992). Jayaram *et al*. (2000) carried out an empirical study of 57 top-tier suppliers to the North American automotive industry to examine the direct and complementary effects of information system infrastructure and process improvements on time performance. The results showed that there is strong support for joint deployment of information system infrastructure and process improvements to improve cycle time performance in a supply chain.

IT solutions enable the participating members to integrate and coordinate various phases of supply chain planning and execution using application software. The aim of this research variant is not only to enhance visibility throughout the supply chain but also to optimise decisions that increase the overall performance. The scope of the research covers various areas of applications such as executive information systems (EIS), warehouse management systems (WMS), enterprise resource planning (ERP), geographic information systems (GIS), and transportation information systems (TIS). EIS - that help the chain members to outsource components of the supply chain  provide tools for optimising the sourcing alternatives and contain software for analysing promotional forecasting and implications (Nickles *et al*., 1998). EIS also provides visibility that reduces the complexity of decision making. For example, the availability of demand data - such as points-of-sale, inventory levels, and customer behaviour - enables a retailing manager to determine ordering schedules that reduce lost sales due to stock-outs.

WMS refers to a software application and hardware that integrate bar coding, radio frequency communication, cycle counting, and other warehouse-related operations to accelerate the flow of material and utilise space throughout the warehouse (Min and Zhou, 2002). A software application such as load planning and optimisation serves to support and improve stock locating, inventory control, material-handling, and productivity measurement. An accurate visibility of the quantity, location, and age of inventory enables users to track and control the movement of inventory through the warehouse from receiving to shipping. According to Richmond and Peters (1998), a WMS has two functions: planning and execution. Planning includes order management, transportation planning, order wave management, labour planning, and dock area management. The execution function covers receiving, put-away, picking and shipping. Richmond and Peters (1998) also suggested a three-phase approach for WMS adoption including operations strategy and software selection, detailed design, and implementation and start-up.

ERP is a multi-module software package for managing and controlling a broad set of supply chain activities including product planning, part purchasing, inventory control, order tracking, and human resource planning. ERP serves as a basis for collaboration to accelerate the velocity of inventory throughout the supply chain. Al-Mashari and Zairi (2000) developed ERP architecture for this purpose based on SAP R/3 comprising of three components: graphical user interface (GUI), application, and database. A conceptual diagram is also proposed to create value-oriented supply chains that enable a high level of integration and communication across supply chain processes.

GIS provides a geographic view of the database information that enables the chain members to visualise geographical aspects of the supply chain using different colours. These systems allow users to analyse sales figures, market activity, customer stores, population density, topography, and climate by zip code, country, and city on a map. By superimposing geographic information, one can differentiate one geographic site from others. GIS also enables the chain members with better information to enhance communication, finding the best locations and the proper number of facilities for a given area, and establishing the most efficient delivery routes and truck schedules (Gates, 1997). Camm et al. (1997) developed a flexible decision support system (DSS) by combining an integer-programming model involving different locations of distribution centres and sourcing of multiple products with GIS. Johnston *et al*. (1999) developed a GIS model for searching near-optimal storage locations for stock items in a multi-facility warehousing environment. Furthermore, Min and Melachrinoudis (2001) combined GIS and a mixed integer programming model to redesign the warehousing structure in a supply chain network to minimise total logistics costs while satisfying capacity, demand, and delivery requirements.

TIS are software solutions that facilitate the sourcing of transportation services, the short-term planning and optimisation of transport activities such as fleet management and pricing, and the execution of transportation plans. Bergmann and Rawlings (1998) proposed four primary categories of the functionality of TIS: transport planning, vehicle routing and scheduling, delivery execution and shipment tracking, and performance management. An effective TIS enables the chain members to coordinate transport shipments in the supply chain network through load consolidation or truck space sharing to increase the utilisation of transport assets, improved delivery routing and scheduling to reduce variable costs, optimisation to generate cost savings, process automation to improve operational efficiency, and visibility to provide insight into critical transportation data (Moozakis, 2001). For example, advance-shipping notices sent via EDI from suppliers to retailers confirming shipment details and delivery times can be used to achieve accurate and consistent delivery performance. This is also in line with a study by Esper and Williams (2003) who found that collaborative transportation management provides benefits for buyers and shippers in terms of reduced transportation and administrative costs, on-time performance improvements, and better asset utilisation.

Information sharing modelling has appeared as a distinct research variant that employs analytical models and standards of information exchange between two or more parties to improve and evaluate mechanisms and benefits of enhanced visibility. To overcome costly traditional EDI, Fürst and Schmidt (2001) proposed a prototype realisation for Internet EDI using XML (eXtensible Markup Language). In their seminal work, Lee *et al*. (1997) characterised information sharing as one of the most critical drivers of supply chain performance. Similarly, Yu *et al*. (2002) developed a model for quantifying the benefits of information sharing in a two-level supply chain. Lee and Whang (2000) reviewed the latest development of information sharing amongst the chain members and identified three alternative models of information sharing including the information transfer model, the third party model, and the information hub model. Mason-Jones and Towill (1999) suggested the information decoupling point to move the marketplace upstream in order to give more players with undistorted data as a key to gaining strategic advantage. Keskinocak and Tayur (2001) conceptually proposed the emergence of quantitative modeling for internet-enabled information sharing.

**Collaborative Business Processes**

Collaborative business processes refer to a set of workflows and decision rights that enable the participating members to deliver joint offerings to end customers. These processes include operating processes (i.e., production, transportation, warehouse, cross-docking, transhipment, distribution, etc.) and management processes (planning and execution). Operating processes describe the sequence in which resources are used and the activities which should be performed in order to deliver products to end customers. Management processes refer to the extent to which the chain members are involved in joint decision rules for planning and execution of operating processes. Research in this area attempts to design and implement streamlined processes that provides values to end customers in an efficient manner. Research variants of this category include: process redesign, supply chain design, management processes, and constraints management.

Research based on supply chain processes views collaboration as a joint effort to redesign supply chain operations that result in better customer service and lower costs (Evans *et al*., 1995; Hammer, 2001). This literature suggests that integrated supply chain processes are necessary preconditions for collaborative outcomes and, thus, a valued focus of research (Croxton *et al*., 2001). The chain members need to engage in reengineering shared processes to facilitate the swift and effective flow of information and collaborative problem solving, so they can expand mutual gains to become greater than the gain that could be generated in isolation. Hammer (2001) argued that streamlining cross-company processes is the next frontier for reducing costs, enhancing quality, and speeding up operations.

There are two strands of process redesign research in terms of the cycle of the process design. First, Hammer and Champy (1993) argue that IT solutions should be taken as the starting point of the design process to achieve dramatic improvements in cost, quality, service, and speed. Since IT provides powerful potential solutions, it replaces existing business processes with new-ones that are fundamentally different. IT solutions can be viewed in terms of the opportunities they present and the problems they might solve, while business processes are redesigned to maximise the use of offered opportunities. On the basis of the resource design a decision structure can be designed to determine decision right assignments and rules. In line with this argument, Short and Venkatraman (1992) argue that the interrelationships between IT and work processes offer the new capability to redefine business network. Business network redesign enables the company to create value-added partnerships with larger business scope for improving product distribution and delivery performance to end customers (Venkatraman, 1994).

The second strand asserts that the design process begins with redesigning the existing business processes as solutions to problems (Davenport, 1993). According to this view, the process structure consisting of a set of resources and workflows between the resources should be redesigned first and followed by a decision structure and information structure. A decision structure can be deduced from the characteristics of processes to specify goals, measures, and decision rights. The information system reflects the decision structure and should be determined after the decision structure is in place. In this way, the information system is viewed as a function of the process structure and the decision structure. For example, Croxton *et al*. (2001) propose key supply chain processes which include customer relationship management, demand management, order fulfilment, and returns. Based on surveys, Bhatnagar and Viswanathan (2000) and Kopczak (1997) confirmed increased supply chain collaboration activity that engaged in significant streamlining of supply chain processes across interorganisational boundaries.

Trienekens and Hvolby (2001) attempt to bridge the dichotomy of the two strands above by arguing that different problems in supply chains require different modelling approaches. They suggest three domains of supply chain reengineering including functions (process), organisation (decision/task), and information and resources. Similarly, in finding common grounds which underlie business process reengineering (BPR) and supply chain management (SCM), Evans *et al*. (1995) contend that companies that have implemented the philosophy of SCM are consistent with the application of BPR in redesigning their supply chain processes. In addition, Berry *et al*. (1999) propose different scopes of business process engineering to improve supply chain performance.

Supply chain design encompasses the configuration of the physical supply chain including the location of the decoupling point that defines where and who designs, produces, and delivers the products across the supply chain in order to minimise total costs (Kopczak and Johnson, 2003). This variant stresses the importance of product design in defining the supply chain and its associated performance. The chain members need to collaborate to design a family of products starting from its preliminary stage, production, and distribution. They may also need to design a suitable configuration that effectively delivers products to end customers. Fisher (1997) argues that the optimal configuration of the supply chain for innovative products is different from that of functional products because of differences in production costs and the costs of a mismatch between supply and demand. Womack and Jones (1994) propose a lean enterprise consisting of a set of groups of companies that creates, sells, and services a family of products to speed up product development in order to expand product offerings. Lean thinking is employed in this approach by cutting out various sources of waste in business processes (Harrison and Van Hoek, 2002). Bowersox *et al*. (1999) proposed lean launch to reduce risk associated with new product launch. This strategy involves a limited commitment of inventory during introductory rollout and a flexible logistics system that rapidly responds to early sales success. An agile supply chain is another initiative of supply chain design that attempts to create a flexible and responsive supply chain that exploits profitable opportunities in a volatile marketplace (Fine et al., 2002; Naylor *et al*., 1999). Other strategies of supply chain design include accurate response (Fisher et al., 2000), build-to-order (Holweg and Pil, 2001), modularity (Baldwin and Clark, 1997), and postponement (Van Hoek, 2001). Product design can be used to effectively match market demand by postponing the point of differentiation in the order-fulfilment process (Lee, 1996; Pagh and Cooper, 1998).

Management processes cover joint planning and execution activities. Supply chain planning aims to generate demand forecast of a product and to develop production and distribution plans for that product. Supply chain execution aims to manage the flow of products through manufacturers, distribution centres, and warehouses to ensure that products are delivered to the right selling points with minimal costs. Interorganisational management processes explain the growing interest in concepts that use collaborative planning to improve forecasting demand accuracy amongst the business partners. The chain members often customise the reference model of collaboration to facilitate their collaborative efforts. A typical example of the reference model for the automotive industry is the CIMSO (computer integrated manufacturing for multi-supplier operations) programme (Schneider *et al*., 1994). The model distinguishes three business processes (buy, produce/store, and sell) within each participant. Process chains linked through buying and selling enable the chain members to identify all actors subsequently adding value to the product flows. The result of the process mapping is reference models that can be used to identify the information to be exchanged throughout the supply chain. Another reference model relies on the use of a collaborative management process to facilitate supply chain collaboration (Ireland and Bruce, 2000). Quick response (QR) has been known as an earlier version of collaborative management process (Fiorito et al., 1995; Perry and Sohal, 2000). Kurt Salmon Associates promoted Efficient Consumer Response (ECR) that facilitates planning and execution for efficient promotions, efficient replenishment, efficient store assortment, and efficient product introductions (Blackburn, 1991). Another initiative, called vendor-managed inventory (VMI), relinquishes stocking decision rights to main suppliers in such a way the supplier is responsible for monitoring stock levels and for replenishing products sold at the retailer stores (Barratt and Oliveira, 2001).

Furthermore, Sherman (1998) reported a recent movement of Collaborative Planning, Forecasting, and Replenishment (CPFR). CPFR enables the participating members across the supply chain to remain competitive by taking a holistic approach to deliver products to ultimate customers (Barratt and Oliveira, 2001). CPFR is designed to link consumer demand with supply chain planning and execution by promoting a single, jointly owned demand plan and forecast throughout the entire supply chain (Ireland and Bruce, 2000). This approach has the potential to deliver increased sales, interorganisational streamlining and alignment, administrative and operational efficiency, improved cash flows, and improved return on assets (ROA). A recent development called Supply Chain Event Management (SCEM) is a reference model that aims to control a supply chain such that products will arrive in the right locations at the right time (Alvarenga and Schoenthaler, 2003; Strozniak, 2002). The chain members collaborate to monitor moving products, activities, events, and disruptions that take place across the supply chain and to quickly respond to fix bottlenecks and delays that could jeopardise future sales.

Constraints management is a management philosophy, coined by Goldratt (1990), that aims to initiate and implement breakthrough improvement through focusing on constraint(s) that prevents a supply chain from achieving its goal. A constraint is defined as any element or factor that limits the system from doing more of what it was designed to accomplish (i.e., achieving its goal). The fundamental goal of most supply chains is to make more money now and in the future through selling products to end customers. The end consumer is thus the actor who justifies all the chain's activities. The theory of constraints (TOC) paradigm essentially states that every supply chain must have at least one constraint. Constraints management encourages the participating managers of the supply chain to collaboratively identify what is preventing them from moving towards their goals - as well as necessary conditions for achieving their goals - and find solutions to overcome this limitation. According to Kendall (1998), there are three potential weakest links in every chain that block the chain members from moving closer to making more sales: supply constraint someone in the supply chain is choking the supply, market constraint enough capacity to produce products but cannot sell them, and distribution constraint the chain has too much supply in some locations and not enough in others.

Covington (1996) started to apply the TOC thinking process to identify problems in the apparel supply chain and describes the bringing together of managers from different firms to cooperate in improving the overall supply chain profit. Goldratt *et al*. (2000) argued that IT solutions are necessary - but not sufficient - conditions to supply chain success. The chain members should redefine their business rules such as policies and measures in order to tap the benefits of IT solutions. Watson and Polito (2003) compared financial performance between Distribution Resource Planning-based order planning and a TOC-based heuristic for buffering and inventory replenishment. They found that the TOC-based system resulted in better financial performance in terms of inventory costs, retail-level transhipment, and obsolescence expenses. Recently, Simatupang et al. (2004) have contended that managing physical constraints should be combined with redesigning performance metrics that encourage total improvements.

**Collaborative Incentive Schemes**

Besides improving performance through better process coordination and information exchange, the chain members are concerned with capturing mutual benefits. As the chain members have different cost and revenue structures, they also have different individual gains in capturing benefits from collaboration. One of the most difficult problems in supply chains is that the economic interests of the chain members are not always incentive compatible. Even when all members target the same customers, their view of what is the best for customers may not be similar. To address this problem, research on incentive schemes has emerged to place wealth distribution as the main lever of collaboration. Research on incentive schemes suggests that the chain members need to agree about the types of such mechanisms to be used for rewarding collaborative performance (Simatupang and Sridharan, 2002). This research attempts to verify the purposes of incentives, targeted behaviour of incentives, and types of appropriate incentives. Research variants in this category include: performance-based incentives, cost sharing, and risk sharing.

Performance-based incentives deal with how the chain members specify payments that tie to the overall performance which results from collaboration. The chain members realise that compensation is a function of the incremental value that they add to end customers. The compensation system should consider the degree of difficulty of fulfilling services to end customers, the changing roles of the chain members, and differences in value added or contributions given by the chain members. Supply chain contracts generally fall into this category (Grout, 1996; Tsay *et al*., 1999). Corbett *et al*. (1999) empirically showed that successful process improvement, such as inventory management and order fulfilment, has higher probability for success when the chain members become involved in aligning joint optimisation rules with logistics and commercial benefits. Logistics benefits include improvements in operational performance. Commercial benefits depend on how the chain members obtain better profitability from the improvement efforts. Kaplan and Norton (1996) suggest the balanced scorecard to assess and reward the chain members according to their roles and contributions in the supply chain.

Cost sharing refers to how the chain members compensate each other for the costs related to joint offerings. Kaplan and Cooper (1998) suggest activity-based costing to estimate investments of collaboration. Kaplan and Narayanan (2001) argued that customer profitability is the key to aligning incentives between companies and their customers. Valid pricing based on the cost to serve provides an appropriate parameter to determine three actions to improve performance: process improvement, pricing decisions, and relationship management.

Risk sharing refers to how the chain members compensate for risks related to supply and demand uncertainties. Raman (1998) suggested that the chain members need to share risks associated with demand uncertainties such as sharing a portion of markdown costs and rewarding responsiveness needed to eliminate lost sales. Similarly, Abernathy *et al*. (2000) recommend to differentiate stock-keeping units according to their actual demand patters in determining sourcing options that minimise inventory risks during the short selling season. Billington *et al*. (2003) argue that risks can be mitigated and distributed across a portfolio of possible participants through the use of a real-options approach. Bichler *et al*. (2002) proposed flexible pricing as a means of managing the risks of supply and demand uncertainties in business-to-business electronic commerce.

**Collaborative Performance Systems**

Key performance metrics are required to stimulate the chain members to exert the correct behaviours for optimising overall performance such as better asset management and customer value. The wrong metrics will discourage the chain members from attaining overall performance. For example, if the logistics providers define "full-truck load" as a primary metric, they will tend to maximise this metric at the expense of on-time delivery. Performance systems also provide directions and magnitudes for total improvements and thereby determine the ultimate success of collaboration. These systems include metrics, measurement, and evaluation. Metrics are vital indicators that inform people within the supply chain how well activities within a process and outputs of a process are attaining specified targets. Performance measurement is the process of measuring activities or outputs within a specified time frame using their associated metrics. Evaluation provides feed-forward and feedback information that enable the chain members to understand the factors that contribute to high supply chain performance, to control or improve those factors, and to set new priorities.

Research on performance systems attempts to design and implement performance metrics in order to affect and change the chain members' behaviours toward overall performance (Goldratt *et al*., 2000; Simatupang and Sridharan, 2002). Appropriate performance metrics enable the chain members to focus on those of their activities and decisions which improve both individual and overall performance. The chain members also have to ensure the usefulness of the selected portfolio of performance metrics and the performance statistics that are derived from the raw performance data. This means that the portfolio should be readily understandable by decision makers to motivate them to support improvement initiatives that contribute to better customer services and lowered logistics costs as well as providing a guide for action to be taken (Simatupang and Sridharan, 2002; Lambert and Pohlen, 2001). There are three variants in this research stream: performance system redesign, cost management, and benchmarking.

The performance system redesign approach strives to design and implement performance metrics, performance models, and measurement methods as the main concern of collaboration (Chow *et al*., 1994; Holmberg, 2000). Since performance metrics drive behaviour, this approach advocates that designing and measuring appropriate performance metrics can lead the chain members to chase the correct direction and thereby contribute to better performance. Callioni and Billington (2001) find that the chain members need to focus on shared metrics rather than shared benefits so they can measure their own gains using common metrics as the collaboration carries on over time. They propose three key metrics to evaluate the success of collaboration: product availability at the stores, inventory turns in the supply chain, and product sales. Lambert and Pohlen (2001) argue that supply chain metrics are very different from traditional metrics in the way they measure inter-company performance rather than just internal performance. They propose a combined customer-supplier profit and loss statements to capture how collaborative initiatives affect profitability for both firms. Lapide (2000) asserts that supply chain metrics must be common across the chain members to be meaningful. He proposes two types of metrics: process metrics which span the supply chain such as perfect order, cash-to-cash cycle, and new product development and functional metrics that measure the efficiency of work within a department of an individual member. The Supply Chain Operations Reference (SCOR) model also developed a set of performance metrics for collaboration including reliability, flexibility and responsiveness, expenses, and assets/utilization (Stewart, 1997). The participating members collect best-practice information using the SCOR metrics that they can employ to assess and improve their supply chain performance.

In an attempt to find a balance between cost (efficiency) and service (effectiveness), Thomson *et al*. (1999) suggested a new metric referred to as make-to-cash (MTC). MTC is a connected set of processes that start with the completed product and end with the actual receipt of the payment. Farris and Hutchison (2002) introduced cash-to-cash analogues to MTC as a new supply chain metric. In determining the distribution of profits among the value chain activities, Gadiesh and Gilbert (1998) proposed a profit-pool map as a tool to isolate and measure variations in profitability. While facing the need for assessing supply chain investments, Grey *et al*. (2003) suggested return on investment (ROI) analysis to quantify the impact of supply chain initiatives on business value. Balanced scorecard is another model used to redesign performance systems that span boundaries of the participating members (Kaplan and Norton, 2002). This approach balances financial and non-financial metrics based on four perspectives financial, customer, process, and learning and growth to enable the company to collaborate with customers, suppliers, and communities.

The cost management approach enables the chain members to find ways to reduce total costs through collaborative efforts (Carr and Ng, 1995; Cooper and Slagmulder, 1999a; Kaplan and Cooper, 1998). It assumes that reducing total costs of the entire supply chain provides more profits for the chain members to share. The cost management approach encourages the chain members to become more efficient in ways that benefit the entire supply chain. Collaborative programmes do not just reduce overall costs but also increase the ability of the chain members to serve customers better (Cooper and Slagmulder, 1998). They also need to share the additional profits resulting from improvements in order to ensure that adopting interorganisational cost management will benefit individual performance. According to Cooper and Slagmulder (1999a), there are three different ways to reduce costs by using interorganisational cost management: cost management during product development, cost management during manufacturing, and improving the efficiency of the buyer-supplier interface. The chain members coordinate the product development activities so that the products and components can be produced at their target costs. The coordination of product development relies on three enabling mechanisms of cost management: functionality-price-quality (FPQ) tradeoffs, interorganisational cost investigations, and concurrent cost management. Cost reduction during the manufacturing phase can be attained while the chain members coordinate production activities so that products and components can be produced at their Kaizen costs. The chain members need to find ways to make the interfaces between their companies more efficient such as reducing the transaction costs by using EDI and reducing uncertainty by increasing information sharing and shortening cycle times. The cost management research varies around these three domains of cost reductions.

Cooper and Yoshikawa (1994) carried out an exploratory field study in the automobile industry and found that partnering firms have blurred their organisational boundaries to coordinate activities that reduce product development costs. Cooper and Slagmulder (1999b) suggested the three target-costing processes: market-driven costing, product-level costing, and component-level target costing. Cooper (1996) found that Japanese firms have adopted six different techniques to manage the costs of existing and future products. The first three techniques - target costing, value engineering, and interorganisational cost management systems - are designed to manage future products. To manage the costs of existing products, they used product costing, operational control, and Kaizen costing. Lockamy and Smith (2000) suggest that target costing for a supply chain consists of three approaches: price-based, value-based, and activity-based cost management. Berry *et al*. (1997) also initiated studies on the consequences of interfirm supply chains for management accounting practice in European companies. They identified several key features of interfirm cost management such as target costing, open book costing, common and shared cost reduction activities, the multiple balanced scorecard for performance measurements and monitoring, sharing profits and losses, and the sharing of budgets (Cullen et al., 1999; Seal *et al*., 1999).

Benchmarking is defined as the process of analysing the best products or processes of leading competitors in the same industry or leading companies in other industries (Camp, 1995). Benchmarking is relevant in studying the supply chain by measuring the company's products, services, and processes and comparing them against the relevant metrics of successful firms (Christopher, 1998). The advent of supply chain collaboration shifts the focus of benchmarking from a single company level to an interorganisational level (Simatupang and Sridharan, 2004). Several research surveys have shown, for example, that the core of supply chain management is the improvement process at the interorganisational level (Boyson *et al*., 1999; Kopczak, 1997). According to Stewart (1995), a best-in-class supply chain was characterised by the best achievement of both internal-facing measures and customer-facing measures. Christopher (1998) also argued that supply chain benchmarking includes joint practices and achievements of the chain members in the supply chain.

Stewart (1995) reported that Pittiglio, Rabin, Todd, and McGrath (PRTM) generated a comprehensive set of fact-based performance measures that can be used to accurately describe a world-class supply chain of planning, sourcing, making, and delivering activities. This is the first known study that objectively links best practices employed with relative quantitative performance achievements. The study results describe relevant trend information indicating the progress that companies have made towards improving their supply chain operations. Stewart (1997) provided the development of the supply chain operations reference (SCOR) model as the first cross-industry framework for evaluating and improving extended supply chain performance. Geary and Zonnenberg (2000) employed the SCOR model to show that the best-in-class performers gained considerable financial and operating advantages over the rest of the respective groups. By using system-wide revenues and costs, Ramdas and Spekman (2000) also examined collaborative practices between high performers among innovative-product supply chains and high performers among functional-product supply chains.

As companies move toward closer arrangements with their partners, they become involved in the progressive process of collaboration. Poirier (1999) proposed a progressive framework consisting of four levels of supply chain optimisation, namely sourcing and logistics, internal excellence, network construction, and industry leadership. In a similar vein, Polese (2002) developed a supply chain maturity model that reflects how companies progress in terms of operational capability. There are four stages in the supply chain maturity model. The first two levels are functional focus and internal integration. Collaboration is the key ingredient to reach stages three (i.e., external integration) and four (i.e., cross-enterprise collaboration). In conjunction with the SCOR model, the maturity model can be used to measure fact-based benchmarking for determining best-in-class performance opportunities. Most recently, Simatupang and Sridharan (2004) have recommended an integrative benchmarking scheme for supply chain collaboration that links enabling practices (i.e., information sharing, decision synchronisation, and incentive alignment) and a collaborative performance system.

**Discussion**

This paper makes two contributions to the understanding of different research streams in supply chain collaboration. The first contribution involves the integrative approach to recognise the different amount of attention paid to each research stream. While different streams of collaboration have been previously studied as is shown by a great variety of literature, involving research on information systems, operations management, and management accounting, these literatures do not, in most cases, refer to each other. They have developed into separate bodies of work through the accumulation of individual studies, each of which focuses on a particular instrument. Most of previous research simply blurs or subordinates other instruments. For example, the focus on collaborative business processes (cell 2) subordinates information systems (cell 1). There is a partial attempt to bring them together and thereby they provide overlapping focused instruments in the attempt to improve supply chain performance. This suggests the need for a broader approach to acknowledge these differences. The taxonomy proposed in this research thus provides a more comprehensive approach than does much of the work on review studies of collaboration in integrating diverse literature to identify and unify different instruments in supply chain collaboration.

The second contribution is to locate the specificity of previous work in the taxonomy. In this way, the research subject of previous work is clearly identified rather than broadly generalised. There are more than eighty previous works included in this research. By highlighting the importance and significance of specificity to previous work, it is expected that different variants would be seen within the taxonomy. Similarly, it would be interesting to trace more specifically the ideas contained in the diverse literatures inside the four cells of the taxonomy.

This research provides several implications for future research. At the general level of the taxonomy, one finding is that that there are different levels of interactions between the research streams: information, processes, incentive, and performance. Considering these interactions bring new insights to the chain members. Constantly balancing information systems, business processes, incentive schemes, and performance systems leads to an iterative design process, rather than a sequential one. Only if the four streams are in balance can a specific instrument of collaboration be used to leverage supply chain performance. The importance of the complementarity view between the research streams has received attention in previous studies (e.g., Milgrom and Roberts, 1995; Simatupang et al., 2002). Future research is required to exploit the complementarity property between the four research streams.

Second, previous study on supply chain collaboration recognises the importance of change management (Callioni and Billington, 2001; Corbett et al., 1999). The model of change management in supply chain collaboration is often typically structured towards a managerialist frame (Morgan and Sturdy, 2000). A managerialist frame broadly accepts that change is initiated on the basis of how the top managers of the chain members define the situation or problem (such as increased competition) and then their efforts to stimulate action. The authors advise how best to define and achieve goals, typically through universalistic prescription such as radical, incremental, top-down, bottom-up including a contingent approach to change methods. As many companies attempt to adopt supply chain collaboration such as CPFR, change management becomes an important topic for future research. Further research will reveal how the chain members analyse their interorganisational situations and the need for change, create the shared vision and direction for successful CPFR, create a sense of urgency, and develop enabling interorganisational structures. Different enabling factors in information systems, business processes, incentive schemes, and performance systems are required in different contexts of collaboration. More empirical work needs to be done to examine change management in supply chain collaboration.

Third, in relation to change management, there are three other issues that need to be researched further, namely leadership, project management, and collaborative teams. Collaborative leaders such as Dell, Hewlett-Packard, and Wal-Mart are well known examples that exhibit the importance of leadership in ensuring successful collaboration (Kumar, 1996; Sherman, 1998). There must be a collaborative leader to initiate and maintain interorganisational norms to achieve desired conditions (Andraski, 1998). The second issue relates to how the chain members apply project management to move from one state to another state that brings them closer to common objectives (Dearth, 2003). Future research requires a novel project management that leads to successful implementation of supply chain collaboration. Third, while this study implies that interorganisational norms affect cross-functional teams that represent the organisations of the chain members, little attention has been given to the team approach in managing supply chain collaboration in previous studies. Christopher (1998) asserts the importance of multicontacts across boundaries of the chain members. For example, logistics and marketing teams from the supplier need to cooperate with the retailer's logistics and purchasing teams. Ancona *et al*. (2002) also argued that cross-functional teams from different companies determine successful product development and delivery. This suggests the need for studying supply chain collaboration from the team perspective to examine how information systems, business processes, incentive schemes, and performance systems can be used to enhance the effectiveness of collaborative teams.

Fourth, little attention has been given to scrutinising the practice of supply chain collaboration from a critical perspective (Knights and Willmott, 2000). Previous research has often assumed that the adoption of supply chain collaboration is a technical change. However, the acceptance of supply chain collaboration is not only a technical matter but also a political change. Future work is needed to examine interorganisational politics amongst the chain members and this should be concerned with investigating how they question and interpret various instruments in supply chain collaboration.

At the specific level of the taxonomy, each research stream provides several opportunities for further research. First, further research in collaborative information systems should examine the importance of data mining to improve the accuracy of demand forecast, coupling IT solutions with changes in interorganisational policies and rules to ensure the achievement of expected outcomes (Goldratt *et al*., 2000), and developing decision support systems embedded in the internet to facilitate intelligent decision making (Keskinocak and Tayur, 2001). Second, future research in collaborative business processes should relate mainly to the development of adaptive supply chains that take into account tools for creating flexible and responsive supply chains and collaborative cost management to facilitate the elimination of variations and costs. Third, the equilibrium of incentive schemes requires further research. The chain members need to ensure that profit sharing and the apportionment of benefits to managers and employees is kept in equilibrium to provide appropriate incentives for the chain members to improve overall performance (Shah, 2001). Fourth, future research in collaborative performance systems is required to enable the chain members to trace revenues and total supply chain costs of supply chain activities as a reliable guide for future decisions to improve those activities that lead to better profitability.

**Concluding Remarks**

Supply chain collaboration has become an important cooperative strategy to enhance the collective advantage of independent companies belonging to a supply chain. Close collaboration enables the chain members to create the flexibility and responsiveness required to succeed in intense competition. However, supply chain collaboration is not only viewed as interorganisational business processes that match demand with supply. To better understand supply chain collaboration, it is necessary to develop a taxonomy that reveals different foci of how to leverage supply chain performance. On the basis of interorganisational norms and the nature of the linkages between chain members, a taxonomy was developed to identify four distinct research streams that individually look at specific instruments used to leverage overall performance. The four research streams are collaborative information systems, collaborative business processes, collaborative incentive schemes, and collaborative performance systems. By trying to draw out the relations between interorganisational norms and the nature of linkage between the chain members, it is possible to unify these four streams that were formerly treated as being unrelated. This paper is presented, therefore, as a stimulant for discussion both in terms of how to trace previous work on supply chain collaboration and how to provide directions for future research.

The research in this paper implies that the design task at each cell of the taxonomy needs to be assessed and aligned with other cells. It is through such a crosscheck that the use of instruments of collaboration can enable the chain members to achieve better performance. Although establishing the parameters of research focus is not a guarantee for collaborative success, the wrong structure will deflect the chain members from doing their jobs and attaining better performance. Because of this, it is believed that selecting appropriate instruments, on the basis of their abilities to influence productive behaviour while still enabling the chain members to share information and coordinate work processes with each other, will grow in importance.

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