Research in Supply Chain Management as part of the e-business

1. Introduction

The rapid development of information technology (IT), especially web-based information transfer between companies, their suppliers, their customers, and various service providers, has improved information management in supply chains (Johnson and Whang, 2002). Additionally, companies are increasingly dependent on collaborative business processes where effective information sharing is an important success criterion (McLaren et al., 2002). It is thus clear that IT and the emerging e-business applications and related new business models are gaining a pivotal role in managing supply chains (Brynjolfsson and Kahni, 2000) as firms are able to demonstrate reduced costs and increased responsiveness of their supply chains through e-business investments (Chopra and Mendil, 2001; Dagenais and Gautschi, 2002; Lee, 2000). Despite the initial enthusiastic expectations and some success stories, it is still not completely clear how relevant these technologies are for different companies and for different business situations and what actual benefits can be obtained and how.

Furthermore, it has been reported that supply-chain collaboration has proved difficult to implement in practice as there has been an over-reliance on technology and a failure to understand what information needs to be shared and, especially, how the business processes need to be changed when new technology is implemented (Barrat, 2004).

Therefore, understanding the value of e-business to supply chain management (SCM) is a vitally important issue in today's technology-intensive world. More knowledge of the impacts of e-business is needed to be able to capture the full potential of these emerging technologies and business processes (McLaren et al., 2004). However, the close relationship of the two concepts, SCM and e-business, make it hard to assess what type of impact e-business has on SCM. Some demonstrate instant payoff, which can be traced directly to the profitability of the organization. Others are more complicated, having a lag between the investment and expected payoff. Furthermore, empirical evidence of the actual benefits of IT and e-business in SCM is less clear (Cagliano et al., 2003; Wu et al., 2003).

It is thus challenging to capture interactions between IT and the business environment and consequently provide a basis from which to evaluate the value of e-business to supply chain management. We need an understanding of the phenomenon for theory building and theory testing; practitioners require it for improving organizational processes. We need to improve our understanding of ways of capturing the potential of e-business in supply chain management.

So far, however, we are still in the first stages of increasing the recognition of the potential of e-business, many organisations still lack an effective ICT infrastructure, which may organise, support and facilitate the highly complex and often rapidly changing interfaces among the organisational entities and disciplines involved in business processes. It is important to note, however, that organisation embarking on an e-business initiative have to consider a sensible alignment of technology (as an enabler) with their business strategy in order to be successful. The introduction of e-business might serve to enforce necessary changes in organisational structures and processes.

e-Business can drive new organisational forms (such as a virtual organisations), fulfil certain tasks in the inter-firm context and allow firms to improve supply chain processes. Therefore, e-business has a vital role to play in integrated SCM.

2. Literature review

This literature review presents the basic concepts and theories that are essentially linked to the research problem and questions. We start by defining e-business in relation to supply chain and supply chain management. Then various e-business tools and methods are briefly introduced. After that, we discuss the body of knowledge relating to the topic of how e-business impacts supply chain management. Subsequently, we cover factors identified in the literature that make researching e-business within the supply chain management domain challenging. Lastly, the chapter is summarized by highlighting the key findings of the literature review.

Business defined in relation to supply chain:

Before moving to the definitions of e-business, we start by defining supply chain and supply chain management. Both of these concepts have many explications among the research and practitioner communities. A definition by Mentzer et al. (2001a, p.5) is one of those most referred to: “a supply chain can be defined as three or more organizations directly linked by one or more of the flows of products, services, finances, and information from a source to a customer”. According to the end-to-end view, the supply chain should contain all the elements from primary supplies for a particular industry or company through the final consumption and return or recycling of the finished products through an end consumer group (Mentzer at al., 2001b). This end-to-end view is analogous to the extended enterprise concept of Simci-Levi et al. (2003) that consists of different upstream and downstream companies and various service providers that operate within the supply chain.

Supply chain management includes the methods, systems, and leadership that continuously improve an organization’s integrated processes for product and service design, purchasing,

inventory management, planning and scheduling, logistics, distribution, and customer satisfaction (Mentzer et al. 2001a). These factors are more and more being accomplished in a collaborative manner across a network of linked business partners (Golicic et al., 2002; Barrat, 2004). Supply chain management issues can be classified into two broad categories: configuration (design-oriented) issues that relate to the basic infrastructure on which the supply chain executes and coordination (execution-oriented) issues that relate to the actual execution of the supply chain (Swaminathan and Tayur, 2003). Configuration-level issues include topics such as procurement and supplier decisions (supplier selection, outsourcing decisions, procurement policies etc.), production decisions (manufacturing sites, capacity allocations etc.), distribution decisions (channels, distribution and retail locations, transportation issues etc.), and information support decisions. Respectively, coordination-level issues comprise material flow decisions, information flow decisions, and cash flow decisions. It is thus clear that supply chain management spans several functional and geographical areas, introducing complexities both in terms of design and execution.

Also, e-business has many definitions. It can be loosely defined as a business process that uses the Internet or other electronic medium as a channel to complete business transactions (Sawaminathan and Tayur, 2003). IBM's Advanced Business Institute defines e-business as "an organizational strategy linking IT and the World Wide Web to create strategic advantage through operational efficiency, customer relationships, innovative products and services, and speed" (Flurry & Vicknair, 2001). Additionally, it is seen as a wide-ranging topic related to supply chain integration and includes a number of different applications and uses of web based technologies, mainly the Internet (Cagliano et al., 2003), as the primary communications medium (Bauer et al., 2001). Simci-Levi et al. (2003) defines e-business as a collection of business models and processes motivated by Internet technology, and focusing on the improvement of extended enterprise performance. Actually, it has always been theoretically possible to broadly integrate with customers and suppliers but it is only through a combination of theory and the Internet that it has become practical (Bowersox et al., 2000). If there is variety in the definitions of e-business, there are also several different classifications that illustrate the diversity of e-business applications. Johnson and Wang (2002) present a framework that divides the various forms of e-business applications into three categories: e-Commerce, e-Procurement, and e-Collaboration. e-Commerce allows a network of supply chain partners identify and respond quickly to changing customer demand captured over the Internet. e-Procurement allows companies to use the Internet for procuring various materials, as well as handling a range of logistical services such as transportation and warehousing. e-Collaboration facilitates coordination of various decisions and activities beyond transactions among the supply chain partners. It is business-to-business interactions facilitated by the Internet. These interactions go beyond simple buy/sell transactions and, according to Lee and Wang (2001), they may be better described as relationships.

Whatever the classification, the most typical task of e-business and related IT in supply chain management is the reduction of the friction in transactions between supply chain partners through cost-effective information flow (for example, Cross, 2000). Conversely, IT and respective e-business tools and methods are more importantly viewed as having a role in supporting the collaboration and coordination of supply chains through information sharing (for example, Lee et al., 1997 present IT as one of the key cures for bullwhip effect in supply

chains). According to Simchi-Levi et al. (2003), objectives of e-business in supply chain management are to provide information availability and visibility, enable single point-of contact of data, allow decisions based on total supply chain information, and enable collaboration with supply chain partners. Additionally, e-business tools can be used for decision support in supply chain management. Then the analytical power of computers is used to provide assistance to managerial decisions related to, for example, co-operation with supply chain partners and inventory management (Simchi-Levi et al., 2003; Swaminathan and Tayur, 2003). Efficiency of information transfer, information availability and transparency of relevant business information are only a few of the benefits provided by e-business solutions to support supply chain integration. The increasing importance and role of e-business in supporting company operations is widely acknowledged both by practitioners (Cagliano et al., 2003; Berger, 2000) and academics (Evans and Wurster, 1999; Skjoett-Larsen, 2000).

e-Business tools and methods:

Development of e-business has created new tools and methods that are driving the recent interest in e-business concepts. These are largely dependent on use of the Internet to support the internal and external business processes of companies. The key tools and methods of e-business include (Bauer et al., 2001):

- EDI (electronic data interchange) and XML (extensible markup language)
- Buy-side e-business applications
- Sell-side e-business applications
- Trading exchanges, i.e., digital market places
- Collaboration
- Content management
- Item identification

Impact of e-business on supply chain management:

Many conceptual papers (for example, van Hoek, 2001; Lee and Whang, 2001; Levary, 2000, Cross, 2000; Bowersox and Daugherty, 1995) discuss how the Internet and various e-business tools and methods impact supply chain management. These papers have often produced expectations that many supply chain problems will be resolved by implementing these new technology and business models. This conceptual discussion is needed, as it shows the potential ability of e-business to improve supply chain management. However, these papers have often been accused of being too optimistic about ways how companies can benefit from e-business in supply chain management. Practical challenges related to the implementation of e-business applications and co-operation difficulties between the supply chain parties are not always included in the discussion in these conceptual papers. There are also a number of articles presenting empirical findings on the impact of e-business in supply chain management. These empirical articles have discussed the issue within a narrow focus; for example, estimating the dollar value of EDI in automotive manufacturer–component supplier relationships (Mukhopadhay et al., 1995) or the impact of enterprise resource planning (ERP) on order completion performance (McAfee, 2002). Thus, there is

still not clear and unambiguous evidence of actual implementation and effectiveness of e-business practices as there is a lack of empirical results that examine the relationship between e-business and supply chain (Cagliano et al., 2003; Wu et al., 2003). In general, the discussion about the benefits of e-business in supply chain management is fraught with problems because of the following points, which have been noted insightfully by Walton and Gupta (1999) in their discussion of the benefits of EDI:

- Some benefits are dyadic, some dependent on both (or a number of) supply chain parties, and some individualistic, i.e., within just one company
- The magnitude of change differs from slight to significant process change and to the creation of competitive advantage
- Depends on the environmental and institutional issues

Thus, the benefits of e-business in supply chain management are manifold. This makes separating the origin of the benefit, whether derived from a particular e-business tool, process change, or both, a difficult, or even, in many cases, an inappropriate, academic exercise. Additionally, as a construct, e-business benefits in supply chain management is so subjective and relative in nature that it would be unrealistic to expect to find a single best theory or framework that would explain the phenomenon (McLaren et al., 2004).

Summary:

Within the scope of this research proposal, the discussion concentrates on the potential benefits of e-business from the supply chain management viewpoint. We see that the benefits of e-business are manifold and include various issues, from small operational improvements to enhanced competitive advantage. Furthermore, the origin of the benefit, whether it is from the technology or from the process change or from both is difficult to separate. Also, the fact that each supply chain has its own unique characteristics adds to the problem; there is a lot of variety in e-business applications in different organizational situations, and even in similar situations there are lots of differences.

It is also important to highlight the difficulty related to the division of benefits to transactional, informational and strategic benefits. It has been asserted that various IT projects have heterogeneous themes in that different projects are expected to fulfil different management objectives (Weill, 1992). Additionally, there is controversy over whether strategic benefits are deliberately planned for. It is often argued that many IT systems that are considered strategic systems started off as simple transaction processing systems (Mirani and Lederer, 1998). Furthermore, strategic issues are often very complicated to describe as there are many interconnected issues related to them. These comments are certainly valid also for e-business in supply chain management. However, the use of the benefits of an e-business framework was a valuable tool in helping to discuss the impact and benefits of e-business to supply chain management in a structured manner.

Conclusion:

As a conclusion, we can state that the literature reviewed shows that the research community has approached the issue impact of e-business on supply chain management from many viewpoints. Yet, most of the research in these areas is rather conceptual. The literature review shows that there is a recognized need for more empirically grounded research to increase our understanding of how companies can benefit from e-business in supply chain management. We need to study the processes that lead to the anticipation of particular types of benefits, to identify the types of benefits that are realized more often, and to examine the reasons behind the benefits. As such, we need more knowledge about the underlying institutions and different business environments that influence the ability of companies to benefit from e-business in supply chain management.

3. Research question and objectives

The aim of this research proposal is to increase our understanding of the role e-business in supply chain management, and to identify different ways in which companies can benefit from e-business in their supply chain operations. The scope of the research problem is extensive; we focus on two more-detailed research questions.

The first is about the allocation of research and development resources and is formulated as follows:

-RQ 1 *"How to focus research and development efforts to maximize benefits of e-business in supply chain management?"*

The second research question is thus focused on actual benefits of e-business implementations, which we look at from the supply chain management point of view. This question is formulated as:

-RQ 2 *"How do companies benefit from e-business in supply chain management*?"

The first research question *"How to focus research and development efforts to maximize benefits of e-business in supply chain management?"* is motivated by the argument that during the late 1990's, when the e-business hype was at its highest, many companies were struggling with the question of how e-business impacts the supply chain (CEST, 2000; Ferrari, 2000). It is agreed that the development of e-business impacts supply chain management in many ways; it brings about new demands on supply chain management on the one hand and provides new opportunities on the other. However, more knowledge is needed to help us categorize and prioritize different, but often interrelated, e-business

issues. This would help both researchers and practitioners to see more clearly the overall impact of e-business on supply chain management. Moreover, as companies increasingly integrate with various services providers (Prahalad and Hamel, 1990), they struggle to understand how permeable their boundaries should be, how to structure interactions with the outside world and how to integrate transactions (Brynjolfsson and Kahin, 2000). Thus, more knowledge as to how research and development initiatives should be focused to help companies build successful relationships with these service providers is needed. During the last few years, e-business applications and related new business models have had a pivotal role in managing supply chains. e-Business development has moved from hype-stage during the late 1990's and early 2000's to the era with many e-business implementations that have had an impact on various supply chain operations. Companies have been able to demonstrate reduced costs and increased responsiveness of their supply chains through e-business investments. Despite some success stories, it is still not completely clear how relevant these technologies are for different companies and for different business situations and what actual benefits can be obtained and how. Conclusion is that research and development efforts should primarily be focused on following three core areas:

- Improved supply chain visibility and supply network integration
- New logistics service concepts and their role in integrated supply networks
- New identification methods such as RFID and their role in integrated supply networks

The second research question *"How do companies benefit from e-business in supply chain management*?" is motivated by the observation that, despite many studies (Lee and Whang, 2001; Levary, 2000; Cross, 2000; Bowersox and Daugherty, 1995) that discuss the benefits of e-business, little published work exists on assessing empirical evidence of actual benefits of e-business investments to supply chain management (vanHoek, 2001; Cagliano et al., 2003; Wu et al., 2003). This is further supported by Gunasegaran (2004) in his recent editorial in the European Journal of Operations Research, where he states that there is still a gap between practice and theory in supply chain management. He highlights the role of e-business in supply chain management as one of the key issues which needs to be addressed with a view to enhancing the application of supply chain management in real-life environments and further theoretical development.

In order to answer the second research question we put forward five propositions. These propositions will be developed during the research. The five propositions are:

- Improved efficiency in supply chain operations allows company personnel to focus more on critical business activities rather than spending time on tedious data processing activities.
- The use of e-business solutions improves information quality within the supply chain.
- Successful companies have developed focused e-business solutions for improving customer service elements that are most important in their business.
- e-Business solutions that are based on planning collaboration improve the agility of the supply network.
- For receiving strategic benefits, the use of the e-business application has to be coupled with process re-design.

4. Analytical framework

We use the "*benefits of e-business-framework"* as a structure of the analysis of what is known about the impact and benefits of e-business in supply chain management. Additionally, the framework is used in identifying relevant research opportunities. The benefits of e-business framework will be developed during this research.

The framework offers three categories of benefits: strategic, informational, and transactional:

- Transactional issues are related to the operational management and help cut costs within the supply chain.
- Informational issues provide the information and communication infrastructure to the supply chain.
- Strategic impacts are related to the changes in how an organization or supply chain competes.

Before moving to the analysis of identified benefits of e-business in SCM, it should be noted that, as there is a lack of empirical results that confirm the benefits of e-business to SCM, we have included some issues presented in more conceptual papers that illustrate potential, rather than realized, benefits. Additionally, it is possible for a single e-business application to have an impact on all three areas: transactional, informational, and strategic.

Transactional benefits:

Transactional benefits are communications efficiency, business efficiency, and systems development efficiency (Mirani and Lederer, 1998). While *communication efficiency* relates to the cost savings in communication, *business efficiency* relates to the possibilities of saving money by either avoiding the need to increase or decrease the work force in a particular task, as well as to other issues that enhance employee productivity or business efficiency. Aspects related to the speed of transactions are also included in the business efficiency component. *Systems development efficiency* covers issues related to the costs of modifying or enhancing current systems, new system development and system compatibility.

Informational benefits:

Informational benefits comprise information access, information quality, and information flexibility (Mirani and Lederer, 1998). Information access refers to faster retrieval or delivery of information and easier access to information. Information quality covers issues such as improved management for strategic planning, improved accuracy or reliability of

information and improved information for operational control. Information flexibility means that it is possible to present information in a more concise manner or better format that will increase the flexibility of information requests.

- The *information access* component refers to the possibility that e-business allows supply chain partners to access various types of data that influences their actions and performance within the supply chain on a real-time and on-line basis (Lee and Whang, 2001). That means faster and/or easier access to internal and external information such as demand data, inventory status, capacity plans, production schedules, promotion plans, and shipment schedules. This is often referred to as improved supply chain visibility (Simchi-Levi et al., 2003: Golicic et al., 2002). Visibility means the possibility of providing each stage in the supply chain insights into such information that is needed in managing the supply chain.
- The i*nformation quality benefits* make the available information more useful, accurate and reliable (Mirani and Lederer, 1998). Information quality has been studied extensively by researchers interested in computing, management information systems, databases and their management, data security and data warehouses to mention but a few (Melkas, 2004). Within a supply chain there are processes that produce information such as planning, designing, selling, or distributing. For this information to have quality, it must be produced according to a well-defined information product specification in the same way that manufactured products are produced (English, 2001).
- e-Business applications also improve *information flexibility*, as the solutions allow decision makers to easily manipulate the content and format of retrieved information (Mirani and Lederer, 1998).

Strategic benefits:

Strategic benefits are divided into the three subheadings of competitive advantage, alignment, and customer relations.

- Competitive advantage benefits help the supply chains to introduce radical changes to their business processes and thereby create competitive advantage for itself or reduce the existing advantage of its competitors.

- Alignment benefits mean that business operations, such as collaboration with supply chain partners are better aligned with companies' business goals. Additionally, it is important to develop such linkages with other organizations that enable supply chains to respond more quickly to changes in the business environment.

- Customer relations refer to improved customer relationship management and customer perception of the supply chain's ability to serve the customer.

5. Methods

This research introduces key e-business tools and methods. The aim is not to cover them extensively, but to give enough background to position the research in relation to the e-business technology infrastructure development. Additionally, diverse issues related to the challenges and hindrances companies are facing when planning and implementing various e-business applications only briefly come within the scope of this research. Likewise, various e-business benefits to other business areas, such as customer relationship management and new product and service development, do not fall within the scope of this research, despite their potential closeness to the issues we discuss.

e-Businness technology infrastructure relates to communication infrastructure and respective software tools and applications (Geoffrion and Krishnan, 2001). Development of e-business has created new tools and methods that are driving the recent interest in e-business concepts. These are largely dependent on use of the Internet to support the internal and external business processes of companies. Some of the tools and methods presented here are more clearly technological; some, in fact, are more like management tools and approaches. The key tools and methods of e-business include (Bauer et al., 2001):

- EDI (electronic data interchange) and XML (extensible markup language)
- Buy-side e-business applications
- Sell-side e-business applications
- Trading exchanges, i.e., digital market places
- Collaboration
- Content management
- Item identification

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