A review on e-SCM topics

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Abstract
This paper analyses the interaction of two topics: Supply Chain Management (SCM) and Internet. Merging these two fields is a key area of concern for contemporary managers and researchers. They have realized that Internet can enhance SCM by making real time information available and enabling collaboration between trading partners. The aim of this paper is to define e-SCM, analyze how research in this area has evolved during the period 1995-2003 and identify some lines of further research. To do that a literature review in prestigious academic journals in Operations Management and Logistics has been conducted.

Keywords:
e-Supply Chain Management, Internet, e-Logistics, Literature review

Introduction

"The supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer" (Christopher 1998).

Enhanced competitiveness requires that companies ceaselessly integrate within a network of organizations. Firms ignoring this challenge are destined to fall behind their rivals. This integration of companies within a network has led to put more emphasis on Supply Chain Management (SCM). "SCM is the management of upstream and downstream relationships in order to deliver superior customer value at less cost to the supply chain as a whole" (Christopher 1998). The integral value of the SCM philosophy is: "total performance of the entire supply chain is enhanced when we simultaneously optimize all the links in the chain as compared to the resulting total performance when each individual link is separately optimized (Burke and Vakkaria 2002).

In order to achieve this coordination/integration of all the links in the supply chain information is critical. Recent technological developments in information systems and information technologies have the potential to facilitate this coordination, and this, in turn, allows the virtual integration of the entire supply chain. The focus of this integration in the context of Internet-enabled activities is generally referred to as e-SCM. Merging these two fields (SCM and Internet) is a key area of concern for contemporary managers and researchers. Managers have realized that Internet can enhance SCM decision making by providing on real-time information and enabling collaboration between trading partners. Many companies have implemented point-of-sales scanners, which read, on real time, what is being sold. These companies do not only collect on real-time information to make decisions about what to order or what to send to the stores; they also send this information, through

Internet, to their suppliers in order to make them able to synchronize their production to actual sales.

The recent proliferation of papers on SCM and Internet related topics explain the increasing interest of researchers for this area. There is a growing stream of literature attempting to better understand the impact of Internet on different SCM activities (planning, distribution, design, etc.). However, there is a disjointed scattering of research activity that fails to clearly represent what should be understood by e-SCM, what we currently know about the effects of Internet on SCM and what we still need to learn.

The aim of this research is to consolidate the existing research efforts concerning the impact of Internet on SCM, and to identify promising areas for study. In particular, the objectives of this study are:

1. To define what can be understood by e-SCM and e-logistics.

2. To determine if e-SCM has been acknowledged as an outstanding topic in the most prestigious Operations Management (OM) and Logistics journals.

3. To identify the main topics of e-SCM during the period 1995-2003.

4. To identify the methodologies used in the existing literature.

5. To identify implications and directions for future research.

The work is organized as follows, in section 2 we present a definition of e-SCM and e-Logistics. In the next section, we describe the impact of Internet on SCM. In section 3, we provide a description of the research methodology followed in this work. In section 4, we present a summary of the research results. And, finally, in section 5, we present some conclusions.

Defining e-SCM and e-logistics

In order to define e-SCM and e-logistics, we need to establish what we understand by SCM and Logistics. We have adopted the definitions of Logistics and SCM proposed by (Lambert, Cooper et al. 1998). For SCM, they suggest to follow The Global Supply Chain Forum. The members of this forum defined SCM in 1998 as *"the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders"* (Lambert, Cooper et al. 1998). And, for Logistics they suggest to adopt the Council of Logistics Management (CLM) definition: *"Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point-of-origin to the point-of-consumption in order to meet customers' requirements"* (Lambert, Cooper et al. 1998). Both definitions entail a supply chain perspective from first supplier to end-user and a process approach. But, the main difference between them is that Logistics is a subset of SCM. Companies have realized that is not only the logistics process that cuts across supply chains, but in principle, all business processes (Lambert, Cooper et al. 1998). According to that, SCM ideally embraces all business processes cutting across all organizations within the supply chain, from initial point of supply to the ultimate point of consumption (Cooper, Lambert et al. 1998). For (Cooper, Lambert et al. 1998), SCM embraces the business processes identified by the International Center for Competitive Excellence (see Figure 1).

We understand by e-logistics and e-SCM the impact that Internet has on Logistics and SCM, respectively. Accordingly, e-SCM will refer to *"the impact that Internet has on the*

integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders". And, e-logistics will refer to "*impact that Internet has on the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point-of-origin to the point-of-consumption in order to meet customers' requirements".* Logistics is a subset of SCM, and accordingly, e-logistics is a subset of e-SCM.

In this paper, we will focus on e-SCM, and therefore, e-logistics will be one of the aspects to be analyzed, but not the only one. E-logistics has traditionally been referred to the impact of e-commerce in the logistics activities, however we believe that Internet has a very important effect on SCM that has been very often forgotten: the coordination and integration aspects.
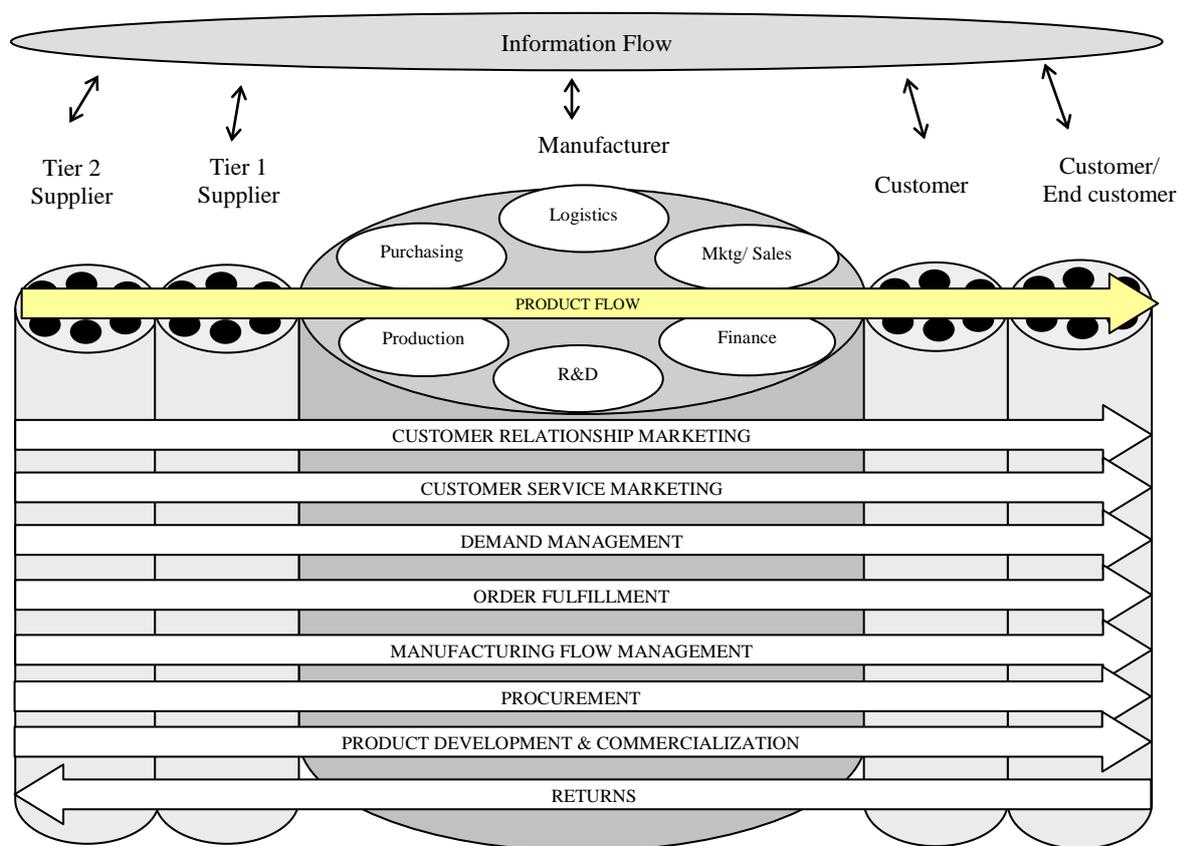

Figure 1. Supply Chain Management. Source: (Cooper, Lambert et al. 1998)

E-SCM and Internet technologies

Internet has had and is having a significant impact on the way companies are conducting business. Internet has created the opportunity to access and share information across the supply chain in a faster and more reliable way. It provides common communication protocols and standards for system inter-operability, enabling reliable and low-cost inter-business connectivity. This flow of information leads to the improvement of productivity, the increase of efficiency and the achievement of better collaboration between the supply chain partners.

However, to take full advantage of the Internet, businesses must restructure their internal and external processes across the supply chain and improve their collaboration.

The first step in this collaboration is just data exchange or information sharing, but a further step consists on sharing knowledge to enable a better planning and decision making across the supply chain. This knowledge is obtained by applying analysis, interpretation or modeling to the information shared.

Internet enables better collaboration, but at the same time, it has opened up a new commercial channel to many firms. Now, customers can buy products and services without going to the store. This new form of selling products and services have a very big impact of firms. Companies that embrace e-commerce have to make changes and adapt their business processes to this new commercial channel.

We consider that the impact of Internet on SCM comprises one or more of the following aspects:

- <u>e-commerce</u>. Internet consists on a new commercial channel where firms sell their products and services. New supply chain processes must be defined in order to answer the challenges of this new channel. For example the order fulfillment process, known in this case as e-fulfillment, needs activities different from the traditional distribution channels.

- <u>Information sharing</u>. Internet is the medium to access and transmit data and information among supply chain partners. This flow of information within the supply chain is, in our days, crucial to carry out an effective and efficient collaboration and integration along the supply chain. Internet offers a high-speed and global medium to enable this flow, which given its open nature, has advantages over other information networks, such as VAN, EDI, etc. One example of this information sharing is the impact of Internet on the procurement process, known as e-procurement.

- <u>Knowledge sharing</u>. Internet not only enables the supply chain partners to access and share information, but also to access data analysis and modeling to jointly make a better planning and decision making. Knowledge is considered, in the Information Systems Management area, the result of applying analysis, interpretation and modeling to information. The access to this knowledge will enable companies not only to share information but also to share planning and decision-making. This collaboration among firms will lead to cost reductions and a better and faster response to the market. Decision technologies that offer the access to this knowledge, or the tools to obtain it, will become an important issue in the future (Swaminathan and Tayur 2003), (Sodhi 2001). One example of this knowledge sharing is the collaborative forecasting. The availability of analytical tools (such as forecasting models) to translate sales data into meaningful knowledge and business intelligence can lead to a rapid decision-making to respond to customer demands.

- <u>Design an efficient supply chain</u>. Managing communication, collaboration and competition is critical to ensure a high level of responsiveness and to maintain an effective cost structure of the supply chain. Internet permits to have access to information and knowledge in a faster and inexpensive way, however, this is not enough to ensure responsiveness and efficiency. To achieve them, there is the need to design the supply chain in such a way that it leads to an efficient flow of goods. Therefore, an impact of Internet on SCM is the need to make more emphasis on designing fast responsive supply chains. (Van Hoek 2001) comments that "the e-

supply chain is the physical dimension of the e-business with the role of achieving base level operational performance in the physical sphere (fulfillment, etc.)".

Other authors have considered similar types of impacts of Internet on SCM. (Lee 2002) suggests also four types of impacts of Internet on the supply chain: information sharing, knowledge sharing, e-commerce (design of new products and services to fit special market segments) and new supply chain structures to serve customers in a more direct way. (Swaminathan and Tayur 2003) briefly describe three ways of how Internet influences SCM: firstly, they consider that Internet has facilitated the use of ERP (Enterprise Resource Planning) and APS (Advanced Planning and Scheduling). Secondly, they consider the impact of Internet on information sharing. And, finally, they consider the possibility of integrating information sharing and decision making across the supply chain.

Research methodology

Journals chosen

This paper reviews the literature in academic journals where OM and Logistics academics and practitioners publish. The objective is to collect, organize and synthesize existing knowledge relating to Supply Chain Management and Internet. We have made a literature review of 13 OM and 5 Logistics journals for the period 1995-2003. OM journals have been chosen through the analysis of previous studies that classified and ranked the most significant OM journals in both U.S. and Europe ((Vokurka 1996); (Goh, Holsapple et al. 1997); (Soteriou, Hadjinicola et al. 1999); (Donohue and Fox 2000) and (Vastag and Montabon 2002)). The 13 OM journals selected are: California Management Review (CMR), Decision Sciences (DS), European Journal of Operational Research (EJOR), Harvard Business Review (HBR), Interfaces (INTERFACES), International Journal of Operations and Production Management (IJOPM), International Journal of Production Economics (IJPE), International Journal of Production Research (IJPR), Journal of Operations Management (JOM), Management Science (MS), Omega (OMEGA), Operations Research (OR) and Production and Operations Management (POM). Logistics journals have been chosen analyzing the reference list of OM and Logistics articles; the most cited Logistics journals have been included in our analysis. These journals are: International Journal of Physical Distribution and Logistics Management (IJPDLM), Journal of Business Logistics (JBL), Logistics Information Management (LIM), Supply Chain Management: An International Journal (SCM) and The International Journal of Logistics Management (TIJLM).

We started our analysis in 1995 because a taxonomy analysis carried out by (Alfaro, Alvarez et al. 2002) permitted to determine that in 1995 just only about 2% of published papers in prestigious OM journals were dedicated to SCM. Also, Internet is a recent information technology. As a result, the research dedicated to SCM and Internet before 1995 must be very limited. Due to the existence of multiple words related to the topic, we spent substantial time in the traditional and electronic library system sorting through the academic and business journals reviewing titles, abstracts and manuscripts. The topics we used to search were: Internet, e-commerce, B2B, B2C, e-SCM, electronic supply chain and information technologies. In total we collected 85 articles.

Classification methodology

We classified the articles collected by topic areas and by research methodologies. The topics selected were related to the processes proposed by (Cooper, Lambert et al. 1998) and (Lambert, Cooper et al. 1998). These processes are: customer relationship management, customer service management, demand management, e-fulfillment, e-procurement,

manufacturing flow management, product development and commercialization, and reverse logistics. We added some topics related to strategic aspects, such as supply chain relationships, planning and optimization tools and information flows. Under information flows we classified the papers that describe how information flows along the supply chain by means of Internet technologies. The topic of supply chain relationships was used to classify the papers that analyze impact of Internet on the supply chain relationships. The papers classified under the planning and optimization topic are the ones that apply planning and optimization systems based on decision models and technologies to several SCM processes. We finally added another topic, e-SCM, under which we classified all papers analyzing different supply chain processes simultaneously.

In order to classify the papers according to the methodology, we used four categories: descriptive, literature review, empirical and decision models. In the descriptive category we classified all papers that describe or present an aspect of e-SCM. In the literature review category we classified the papers whose main objective was to present a review of the work done on a specific topic. In the empirical category we considered the papers based on the results of case studies, surveys or web scans. And, finally, in the decision models category we classified all papers that apply decision technologies, such as data management, statistical analysis, forecasting, data mining, mathematical and optimization models, exact and heuristic solution methods, simulation, economic models, game theory, etc., to help managers to make better decisions.

In order to classify the papers and minimize questions in this process, we listed the possible subtopics by topic. However, we still found some papers whose classification was not easy. In these cases, all the authors were conferred and discrepancies were discussed until a consensus was reached.

When we were addressing the classification according to the methodology used in each paper, we realized that researchers sometimes use more than one methodology. In these cases, we identified all the methods and tried to determine the main contribution of each one to the achievement of the objective of the paper. We, therefore, classified the paper in the methodology category according to the methodology that contributed most to the objective of the paper. For example, one of the papers developed a web dynamic Available-To-Promise system and tested it in a case study. This paper was classified in the decision models category because the main objective of the paper was to develop the system.

Research results

In this section we analyze the information obtained and provide answers to the following research questions: 1) Has e-SCM been acknowledged as an outstanding topic in the literature in the most prestigious journals of OM and Logistics?; 2) Which are the e-SCM topics covered in the most prestigious journals of Operations Management and Logistics? and 3) Which is the methodological profile followed by the e-SCM papers published in the most prestigious OM and Logistics journals?

Has e-SCM been acknowledged as an outstanding topic in the literature in the most prestigious journals of Operations Management and Logistics?

Table 1 shows the distribution of articles along the time and the journals. We have divided the 1995-2003 interval in two periods: 1995-1999 and 2000-2003 in order to identify trends. As it can be appreciated in Table 1, the total number of papers related to e-SCM topics in the OM and Logistics journals has increased considerably. In the 1995-1999 period, there were only 9 articles while in the 2000-2003 period the total number of e-SCM papers was 76. We observe

that the papers published in the 2000-2003 period nearly represent eighty nine per cent of the papers analyzed in our database. The increase in the number of e-SCM papers has been bigger in the OM journals than in the Logistics journals. This demonstrates that the e-SCM topic has gained importance in the research agenda, especially in the OM journals. From the 9 articles published during the first period (1995-1999), there is not any paper published in 1995 and only one paper published during the year 1996. Most of the papers included in this first period have been published in 1999. This suggests that the starting year of the interval object of our research (1995) has been well chosen.

Journal	1995-1999	2000-2003	Total papers e-SCM	% over total papers
OM/OR JOURNALS				
CMR	0	3	3	1.11%
DS	0	1	1	0.30%
EJOR	0	2	2	0.04%
HBR	1	2	3	0.21%
INTERFACES	0	7	7	1.41%
IJOPM	1	6	7	0.87%
IJPE	0	8	8	0.54%
IJPR	0	7	7	0.35%
JOM	1	3	4	1.30%
MS	0	6	6	0.54%
OMEGA	0	0	0	0.0%
OR	0	0	0	0.00%
POM	0	4	4	1.78%
TOTAL OM	3	49	52	
LOGISTICS JOURNALS				
IJPDLM	2	12	14	3.50%
JBL	0	1	1	0.53%
LIM	0	3	3	1.00%
SCM	2	10	12	5.60%
TIJLM	2	2	3	4.00%
TOTAL LOG.	6	27	33	
TOTAL	9	76	85	

Table 1. Articles per journal

Table 1 shows the total number of papers related to e-SCM topics in absolute terms and relative terms. In absolute terms the journals with a highest number of e-SCM papers published are two Logistics journals: IJPDLM and SCM. Among the OM journals, the journals with a higher number of e-SCM papers are: IJPE, INTERFACES, IJOPM, IJPR and

MS. In relative terms (approximate percentage of e-SCM papers over the total number of papers published), the journals with a highest percentage are three Logistics journals: SCM, TIJLM and IJPDLM. The rest two Logistics journals have a percentage similar to the OM journals. Among the OM journals, the ones with a higher percentage are: POM, INTERFACES, JOM and CMR.

OM JOURNALS
• POM: Volume 11 issue 4 (2002): Special issue: "E-business and SCM"
• DECISION SCIENCES: Volume 33 issue 4 (2002): Special issue: "E-business and SCM"
• IJPE: Volume 75 issue 1/2 (2002): Special issue: "Information technology/ Information systems in the 21st century manufacturing"
• INTERFACES: Volume 31 issue 2 (2001): Special issue on "e-business"
• JOM: Call for papers: "The Impact of e-Business Technologies on Supply Chain Operations" (Deadline September 1, 2004.)
LOGISTICS JOURNALS
• IJPDLM: Volume 31 issue 6 (2001): Special issue: Making the e-supply chain a reality through logistics

Table 2. Special issues on e-SCM related topics

Table 2 shows the journals with a special issue on e-SCM related topics. Among these journals, there are some with a high percentage of e-SCM papers and some others with a low percentage. Therefore, it seems that the special issue has not had a very big impact on the percentage of e-SCM papers published.

Which are the e-SCM topics covered in the most prestigious journals of Operations Management and Logistics?

Table 3 shows the topics used to classify the articles and the number of papers published on each. As it can be appreciated in this table, the topics more covered by the existing literature are: e-procurement, e-fulfillment and information flows. The topics least covered are: demand management, customer relationship management and returns and reverse logistics. Regarding the evolution in the topics covered, it can be appreciated that from the twelve topics, only half of them were present in the first period (1995-1999). These were: demand management, e-fulfillment, e-procurement, information flows and product development and commercialization. In the second sub-period, new topics were covered. These are: customer relationship management, customer service, manufacturing flow management, reverse logistics and returns, planning and optimization and supply chain relationships. This suggests that the strategic aspects related to supply chain collaboration and relationships, and planning and optimization have become more important as a result of the increasing relevance of the area of SCM within businesses. The topics more covered in this second sub-period are: e-procurement and e-fulfillment.

TOPIC	1995-1999	2000-2003	TOTAL
Customer relationship management	0	2	2
Customer service management	0	3	3
Demand management	1	0	1
e-fulfillment	1	13	14
Manufacturing flow management	0	4	4
e-procurement	2	20	22
Product development and commercialization	1	5	6
Reverse logistics and returns	0	2	2
Information flows	3	8	11
Supply Chain relationships	0	6	6
Planning & optimization	0	7	7
e-SCM	1	6	7
TOTAL	9	76	85

Table 3. Taxonomy analysis

Which is the methodological profile followed by the e-SCM papers published in the most prestigious OM and Logistics journals?

Table 4 shows the research methodologies used in the papers contained in our database. The methodologies most used have been descriptive, empirical and decision models. Forty one per cent of the papers are descriptive, twenty seven percent are empirical based and nearly twenty five per cent use decision models.

The descriptive methodology has been used in almost all the topics. Only customer service management and reverse logistics and returns have not been covered with a descriptive methodology. The literature review methodology has been used to analyze e-procurement, e-SCM, planning and optimization and product development. All the topics, except demand management, planning and optimization and manufacturing flow, have been analyzed through an empirical methodology. And, decision models have been used in the following topics: e-fulfillment, e-procurement, manufacturing flow, supply chain relationships, information flows, planning and optimization, product design and reverse logistics and returns.

TOPIC	Descriptive	Literature Review	Empirical			Decision Models
			Case Study	Survey	Web scan	
Customer relationship management	1	0	1	0	0	0
Customer service management	0	0	1	1	1	0
Demand management	1	0	0	0	0	0
e-fulfillment	5	0	2	2	1	4
Manufacturing flow management	2	0	0	0	0	2
e-procurement	10	3	1	3	1	4
Product development and commercialization	1	1	1	0	0	3
Reverse logistics and returns	0	0	1	0	0	1
Information flows	5	0	3	0	0	3
Supply Chain relationships	4	0	1	0	0	1
Planning & optimization	3	1	0	0	0	3
e-SCM	3	1	0	3	0	0
TOTAL	**35**	**6**	**11**	**9**	**3**	**21**
TOTAL	**85**					

Table 4. Research methodology

The reader is referred to (Giménez and Lourenço 2004) where a literature review, with a summary of all papers evaluated, and some directions for future research is presented in great detail.

Conclusion

Our paper has contributed to the knowledge on SCM topics by defining e-SCM and e-logistics. Our study has also described the impact that Internet has on the different processes that SCM embrace. And, the literature review undertaken on the topic has shown that e-SCM has been acknowledged as an outstanding topic in the supply chain literature in the most prestigious OM and Logistics journals, specially after year 2000. The main topics have been e-procurement, e-fulfillment and information flows. Regarding methodologies, the descriptive methodology has been the most used, followed by the empirical methodology and the decision models.

We expect that the number of research papers in this area will increase significantly in the next years, given the increased interest in SCM and Internet by academicians and practitioners. Some directions for further research that we have identified are: to conduct empirical studies about the impact of Internet on several e-SCM processes, as for example the reverse and demand management processes which, so far, have only been considered by a couple of authors.

Another important area of research is the application of decision models and technologies on Internet and the development of Application Service Providers (APS) to obtain knowledge for the firms within a supply chain. As more and more firms have high quality and real-time information available, the use of these decision technologies will increase, since they add significant value to the members of a supply chain.

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