e-Supply Chain Management: Review, Implications and Directions for Future Research

E-SUPPLY CHAIN MANAGEMENT: REVIEW, IMPLICATIONS AND DIRECTIONS FOR FUTURE RESEARCH

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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

JEL codes: L290, M100, M110

1. 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 present a literature review of the main topics on e-SCM.

6. 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 4, we provide a description of the research methodology followed in this work. In section 5, we present a summary of the research results. In section 6, we provide a literature review (with a summary of all papers evaluated) and some directions for future research. And, finally, in section 7, we present some conclusions.

2. 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.
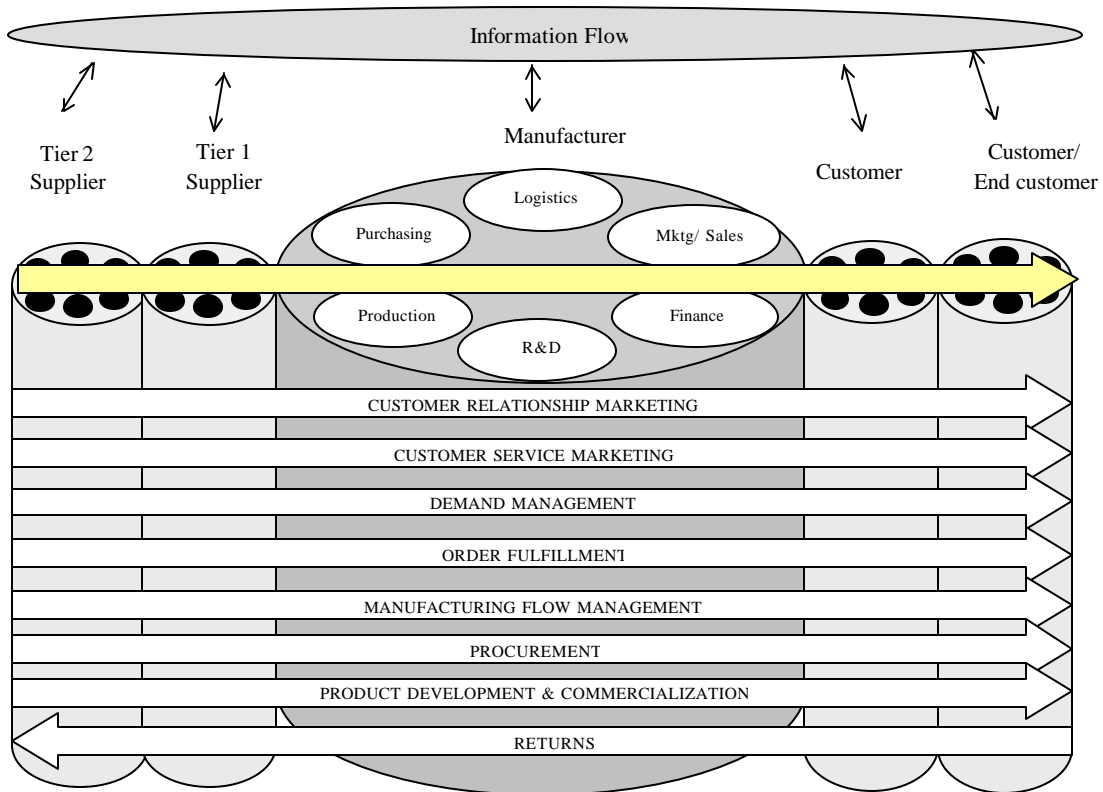
Figure 1. Supply Chain Management

Source: (Cooper, Lambert et al. 1998)

3. 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:

1. e-commerce. 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.

2. Information sharing. 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.

3. Knowledge sharing. 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.

4. Design an efficient supply chain. 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.

4. Research methodology

4.1. 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.

4.2. 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 section 6, we describe in detail each topic.

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.

5. 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? In section 6 we present a summary of all the papers reviewed and identify some lines of further research.

5.1. 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.

Table 1. Articles per journal

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 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.

Table 2. Special issues on e-SCM related topics

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 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.

5.2. *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.

Table 3. Taxonomy analysis

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**

5.3. *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.

Table 4. Research methodology

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**					

6. Literature review and classification

In this section, we briefly describe the SCM processes as proposed by (Cooper, Lambert et al. 1998) and (Croxton, García-Dastugue et al. 2001), and we comment on the impact of Internet on each one of these processes. For each SCM process, we also provide a summary of the existing studies and suggest some directions for further research.

6.1. The Customer Relationship Management process

The Customer Relationship Management (CRM) process provides the structure for how the relationship with the customer is developed and maintained (Croxton, García-Dastugue et al. 2001). This process includes identifying key customers, segmenting them and tailoring products and services to their needs. The process also includes all activities related to working with customers in order to (1) improve processes, (2) eliminate demand variability and non-value added activities, and (3) develop an agreement of metrics.

What is the impact of Internet on this supply chain process? We can distinguish two different types of impacts: Internal and downstream. Internal effects refer to the impact of Internet on the focal company. For example, through Internet all business units can have access to the same information about each customer. This means that all business units will be able to negotiate and relate with customers taking into account the same information.

The downstream effects refer to the impact of Internet on the relationships with customers. One of the most important aspects of the downstream effects is that web sites allow companies to collect data as users navigate around them. This means that Internet can

generate a large amount of data, which can be very useful to CRM if it is analyzed properly with Operations Research (OR) models (Geoffrion and Krishnan 2001), (Sodhi 2001). This has motivated the development of OR-based tools for predicting individual consumers' purchasing behaviors, leading to improvements in forecasting and inventory deployment (Sodhi 2001). Another downstream effect of Internet is that it allows companies to provide new services to customers, increasing the companies' products and services offerings, (Boyer, Hallowell et al. 2002) , (Småros, Holmström et al. 2000).

Table 5 shows the results of our literature review for the CRM process. The existing papers cover the downstream effect related to increasing the products and services offerings. The papers of (Geoffrion and Krishnan 2001) and (Sodhi 2001) , which cover the aspect related to the analysis of the data gathered through the Internet, have not been classified here because they describe some OR tools for planning and optimizing different processes (and not only the CRM process).

Table 5. Literature review: The CRM process

Reference	Abstract	Methodology	Internet impact
(Boyer, Hallowell et al. 2002)	This paper provides an examination of e-services. First, it develops a model of the e-service customer retention. Second, it provides a case study to illustrate how a well-known company can utilize e-services to expand its offerings and streamline its services. Finally, the paper offers a technique for analyzing the benefits and challenges of e-services for particular industries.	Case study	e-commerce
(Småros, Holmström et al. 2000)	To become a profitable growth business, the e-grocery needs to offer customers more value. This paper investigates how such new services can be developed in the e-grocery business. A framework for systematically examining customer demand and identifying corresponding services is presented.	Descriptive	e-commerce

Further research regarding this process should try to analyze how different business units can use the same customer data: What specific type of integration alternatives are available for organizations working with rapidly changing CRM and SCM support technologies? Future studies should also develop decision and OR tools to analyze the large amount of data gathered through the Internet. And, finally, researchers should also provide more empirical studies showing how Internet is used to provide different product and service offerings.

6.2. The Customer Service Management process

The Customer Service Management process provides the firm's face to the customer (Croxton, García-Dastugue et al. 2001). It should be the single source of information to the customer. Real-time information is provided to the customer through interfaces with the firm's functions, such as manufacturing and logistics (Croxton, García-Dastugue et al. 2001).

This process includes strategically aspects, such as the development of the response procedures and the establishment of the infrastructure needed to respond. The process also includes tactical aspects, such as the recognition of the events that require a response, the implementation of the responses and the control of the process.

The most important impacts of Internet on this process are in the internal and downstream parts of the supply chain. In the downstream part of the supply chain, Internet can be used (1) to recognize events and listen to the customer, and (2) to communicate the response procedure to the customer. In the internal part of the process, Internet can be used to enable information sharing on real time among different business units and among different functional areas of a firm. This internal information sharing will improve the response of the company to any event.

The literature review of this process is shown in Table 6.

Table 6. Literature review: The Customer Service Management process

Reference	Abstract	Methodology	Internet impact
(Ellinger, Lynch et al. 2003)	The study was undertaken to provide an overview of the website content within the motor carrier industry and to assess the progress that motor carrier firms are making on this preliminary step in the evolution of their ecommerce processes. The paper analyses the interactivity with customers that the different websites offer, if they provide FAQs and information about their products, etc.	Web scan	Information sharing
(Papathanassiou, Kardaras et al. 2003)	Reports on the results of a survey of 48 Information Systems and marketing managers from food companies in Greece. It studies the potential of ecommerce to improve customer satisfaction in the food industries. The results show that the food companies in Greece have an intra-organizational focus in their e-commerce portfolio, thus advocating applications that support internal processes rather than processes that span organizational boundaries and integrate with customers' business activities.	Survey	Information sharing
(Rae-Smith and Ellinger 2002)	Describes the roll out and initial implementation of an online logistics service system by a Third Party Logistics provider. This system provided the TPL's customers with an industry-leading interactive B2B. The B2B provided online order entry and a portal to update the status of orders (schedule and delivery status).	Case study	Information sharing

(Ellinger, Lynch et al. 2003) and (Rae-Smith and Ellinger 2002) cover the downstream part of the process, showing some examples of how companies communicate, through Internet, with their customers. (Papathanassiou, Kardaras et al. 2003) covers not only the downstream part of the customer service management process but also the internal one: this paper analyses the impact of Internet on the intraorganizational (internal) and interorganizational (downstream, in this case) environments. All three papers are empirically based and cover the information sharing aspect of Internet. Further research should follow the perspective of (Papathanassiou, Kardaras et al. 2003) in order to analyze intraorganizational and interorganizational effects simultaneously. The Internet aspects to

analyze will continue to be information sharing, as it is the only aspect that will affect the customer service management process.

6.3. The Demand Management process

The Demand Management process needs to balance the customers' requirements with the firm's supply capabilities (Croxton, García -Dastugue et al. 2001). This includes forecasting demand and synchronizing it with distribution, production and procurement.

Internet impacts this process along all the supply chain. Information sharing, through Internet, about actual sales enables companies to improve their forecasts. This affects the internal part of the supply chain (the focal company), but it also affects its upstream and downstream links. For example, in the grocery industry a manufacturer can receive information about the actual sales of its products at the stores of one of its customers. Internally, this information sharing can improve its forecasts, leading to an improvement in production planning and a reduction in stock levels. Downstream, this information sharing enables the customer (the grocery company) to eliminate the replenishment orders. Replenishment decisions can now be taken at the focal company, which is now responsible to maintain its customer stock levels between a maximum and a minimum level. This means that the grocery customer reduces its order process costs and the stock levels (because its supplier's forecast are better and stock-outs have decreased). Upstream, the information obtained about actual sales can be also shared with the focal company's suppliers. This will improve the suppliers' forecasts, leading to an improvement in their production planning and a reduction in stocks.

Internet affects this process along the supply chain, not only on the information sharing aspect, but also on the knowledge share aspect. Some companies have implemented Collaborative Planning Forecasting and Replenishment (CPFR) programs. In these programs, customer, focal company and supplier do not only share information, they plan together. In a CPFR program a forecasting support system is hold on an Internet server. This support system is updated with data from actual sales and other information provided by the grocery company and the manufacturer and provides the forecasts to the grocery retailer, the manufacturer and its suppliers. In September 1999, Henkel and Eroski (a Spanish grocery retailer) initiated a CPFR program. It resulted in an important improvement in the forecasts of both companies. Before implementing the program, half of the forecasts had a forecasting error higher than 50%. Nine weeks after the implementation of the program, 75% of the sales forecasts had an error lower than 20%, (Jouenne 2000).

Table 7 provides a summary of the literature review regarding the demand management process. (McGuffog and Wadsley 1999) cover the information and knowledge share aspects of Internet and consider the effects of e-commerce and collaborative planning on the supply chain as a whole. Further research should consider empirical analysis to determine the level of implementation of collaborative planning (such as CPFR) and collaborative replenishment (such as CRP) systems in different industries and the effects of this knowledge sharing on the performance of the supply chain. Collaborative planning includes the forecasting aspect of the demand management process, while collaborative replenishment covers the synchronization part of this supply chain process.

Research on decision models that can help managers to make collaborative planning along the supply chain is needed. We expect that multi-decision models which consider the objectives of the different companies will play an important role in these decision and planning systems.

Table 7. Literature review: The Demand Management process

Reference	Abstract	Methodology	Internet impact
(McGuffog and Wadsley 1999)	The paper describes the impact of e-commerce and collaborative planning through the Internet on reducing costs and uncertainty in supply chains.	Descriptive	Information and knowledge sharing

6.4. The e-Fulfillment process

Order fulfillment is related with the effective management of all activities needed to deliver the order to the customer. At the strategic level, there exists the need to design an efficient supply chain to enable a timely and accurate order fulfillment. At the operational level, the order fulfillment process consists on defining the following activities: to generate, to communicate, to enter, to process, to pick and to deliver customer orders (Croxton, García-Dastugue et al. 2001). In a way, this process is about the integration of the manufacturing, logistics and marketing functions to ensure customer satisfaction and reduce total cost before, during and after the order fulfillment.

The impact of Internet on the order fulfillment process has two main aspects. The first one is related to e-commerce and consists on fulfilling the customer orders placed through Internet. From the point of view of the customers, Internet has made the placement of orders more efficient. However, for the selling companies, the order fulfillment can be more expensive and, for physical goods, it is, without any question, a critical operation to obtain customer satisfaction. (Lee and Whang 2001) comment that to obtain an efficient order-fulfillment, new innovative strategies based on a good use of information and leveraging of existing resources must be applied.

The second aspect is related to the use of Internet to improve the efficiency of the order fulfillment process for both online and offline businesses. The order fulfillment process requires the access and manipulation of a large amount of data, from customer orders to inventory levels. Therefore, the advantage of accessing and sharing data along the supply chain using Internet technologies can make this process more efficient and less costly. The possibility of all partners in a supply chain to see customers orders on real-time, or near real-time, can lead to a significant reduction of variability and costs and, at the same time, improve the responsiveness of the firm. But, firms can go a little further and use this data to generate knowledge by applying sophisticated analytical tools to anticipate changes and be better prepared to respond to customers' demand. At the operational level, these tools can go from statistical forecasting methods to analyze customers orders, to inventory systems to obtain the optimal inventory, to vehicle routing systems to design the most efficient delivery routes. And, at the strategic level, these analytical tools can be used to design the most efficient supply network.

Table 8 shows the literature review regarding the impact of Internet on the fulfillment process. One of the most covered Internet impacts related to this SCM process is the e-commerce. This is due to the importance this process has on B2C. This impact has been studied by the following authors (Boyd, Hobbs et al. 2003), (Da Silveira 2003), (Delfmann, Albers et al. 2002), (Kämäräinen 2001), (Kotzab and Madlberger 2001), (Marinus and De Koster 2002), (Punakivi, Yrjölä et al. 2001), (Starr 2003) and (Yrjölä 2001). The impact of Internet on this process regarding information sharing has been covered by four papers: (Crowley 1998), (Kelleher, El-Rahalibi et al. 2003), (Lee 2002) and (Vannieuwenhuyse, Gelders et al. 2003). (Lee 2002) describes how information sharing can lead to a more efficient supply chain. (Crowley 1998), (Kelleher, El-Rahalibi et al. 2003) and (Vannieuwenhuyse, Gelders et al. 2003) focus on the impact of information sharing on transportation decisions such as routing and mode selection. Finally, some authors analyze how Internet can be used to design an efficient supply chain: (Delfmann, Albers et al. 2002) covers the logistics service providers industry, (Dewman, Freimer et al. 2000) the information goods sectors, and (Marinus and De Koster 2002) and (Yrjölä 2001) the food and grocery industries.

Table 8. Literature review: The e-Fulfillment process

Reference	Abstract	Methodology	Internet impact
(Boyd, Hobbs et al. 2003)	The objective of this work is to evaluate the impact that customs and inspection fees have on B2C e-commerce for food products. The authors conclude that the customs and inspection fees have an important impact on the expansion of e-commerce into international markets.	Descriptive	e-commerce
(Crowley 1998)	The work analyzes the impact of information technologies on transportation, and in particular in the demand for transportation and the respective market.	Descriptive	Information sharing
(Da Silveira 2003)	The objective of the work is to identify the distinctive competencies in the operations management of e-commerce companies. The study concludes that Operations Management plays an important role in the e-commerce and this requires the development of a series of distinctive competencies.	Case study	e-commerce
(Delfmann, Albers et al. 2002)	This paper analyses the impact of e-commerce on logistics service providers. It argues that the logistical implications of e-commerce can be differentiated into two main categories: the rise of e-marketplaces and the elimination of supply chain elements (disintermediation). The flexible capacity management and the global presence are the two fundamental strategies for the logistics service providers to address the challenge of the e-commerce.	Descriptive	e-commerce Efficient SC design
(Dewman, Freimer et al. 2000)	This article studies the design of the distribution channels for information goods using Internet. The authors present a Nash equilibrium of the competitive game between Internet Service Providers and Property Content Providers to analyze the impact of the distribution channel on the firm's performance. This work is related to distribution network design for information service industries.	Decision models	Knowledge sharing Efficient SC design

Reference	Abstract	Methodology	Internet impact
(Kämäräinen 2001)	This paper examines how different solutions for grocery home delivery affect the service levels offered to consumers. The different solutions include pick-up by customer, shared reception boxes, own reception boxes and attended reception. The major conclusion is that the way e-grocery consumers receive the goods has a major impact on the grocery supply chain.	Decision models	e-commerce
(Kelleher, El-Rahalibi et al. 2003)	This work presents an Internet-based system, called PISCES, that supports the control, expedition and scheduling of multimodal transportation, in particular container transportation. The paper also demonstrates how information from an Internet system can be used to improve and optimize the transportation routes.	Decision models	Information and knowledge sharing
(Kotzab and Madlberger 2001)	Assuming that stored-based retailers consider electronic retailing as an alternative distribution channel, the authors developed and applied a Web-scan framework to analyze the Web offering and logistics elements of several European e-tailing firms.	Web scan	e-commerce
(Lee 2002)	The author describes how demand and supply uncertainties should be used to design the right supply chain strategy. The Internet plays an important role in the development of this design, since the information sharing and collaboration can lead to more efficient supply chains, in particular for innovative products with unpredictable demand.	Descriptive	Information sharing Efficient SC design
(Marinus and De Koster 2002)	This paper investigates the relation between the constructs: operational complexity, web-based orientation of the company and the company's distribution structure used for the fulfillment of Internet orders. The authors conclude that different fulfillment options are possible depending on the type of food-retail company.	Survey	e-commerce
(Punakivi, Yrjölä et al. 2001)	The work analyses the problem of the "last mile" in e-commerce, which is particular important and difficult for food companies. The authors perform a simulation to evaluate the impact of unattended reception of goods using two main solutions: reception box and delivery box. The conclusions suggest that the unattended reception of goods reduces home delivery costs considerably, by up to 60%.	Decision models	e-commerce
(Starr 2003)	This paper analyses the impact of OM on the profitability of B2C. It analyses the annual reports of one e-retailer, Webvan, and 12 surveys from other firms operating in the B2C world. The main objective of the work is to evaluate the impact of Operations Management on the Webvan's business failure. The paper suggests that the Internet retailing model is a challenge for operations management, which has yet to learn about the best way to deal with the marriage of in-store and Internet systems.	Case study	e-commerce

Reference	Abstract	Methodology	Internet impact
(Vannieuwenh uyse, Gelders et al. 2003)	The authors present a survey that analyzes the logistics decision maker's perception concerning the transportation modes. An Internet-based tool to support the transportation mode decision process based on Multi-Criteria Decision Making is also presented.	Survey[*] Decision models	Information and Knowledge sharing
(Yrjölä 2001)	This work analyses several supply chain structures for electronic grocery shopping: a model based on a local distribution center and a hybrid model using a local distribution center and a store. The author evaluates the cost structure of these supply chain structures using simulation techniques.	Descriptive	e-commerce Efficient SC design

The directions for further research can enter into one of the following categories: (1) better use of information and creation of knowledge by using actual and new analytical and decision tools; (2) new strategies applied to the e-fulfillment activities; and (3) more empirical research work, including case studies and business models, about the implementation of e-fulfillment.

With respect to the first line of further research, the access to more data and information will put more emphasis in global optimization along the entire supply chain, instead of the usual models that focus on local optimization. More work considering the global supply chain will appear in this area. Also, more models using multi-criteria decision making that reflect the integration and collaboration aspects of the e-fulfillment process will be the subject of future work.

Regarding the study of new strategies for the e-fulfillment activities, one problem that looks like it needs more research is the so-called last mile. New delivery solutions or strategies that can combine profitability and service are still needed. The use of knowledge management, operational research and simulation techniques will be a must in the solution of this important problem of the e-commerce for physical goods. For example, (Tyan, Wang et al. 2003) suggest to use these techniques to study the problems related to freight consolidation.

Further research should also focus on empirical studies, as very few papers on this process are field-based.

6.5. *The Manufacturing Flow Management process*

The Manufacturing Flow Management process deals with making the products and establishing the manufacturing flexibility needed to serve the target markets (Croxton, García-Dastugue et al. 2001). The process includes all activities necessary for: (1) managing the product flow through the manufacturing facilities, and (2) obtaining, implementing and managing flexibility (Croxton, García-Dastugue et al. 2001).

Internet can have a positive impact on both aspects of the Manufacturing Flow Management process. On one hand, Internet provides the opportunity for demand data and

supply capacity data to be visible to all companies within a manufacturing supply chain, and therefore, the product flow through the manufacturing facilities can be improved. This visibility allows companies to be in a position to anticipate demand fluctuations and respond accordingly. The main effect is to reduce stocks and compress lead times. On the other hand, Internet allows companies to be more flexible to respond to changes in demand. Internet reduces the production cycles due to an increase in the speed of communication. "Companies like IBM, General Motors, General Electric and Boeing are assembling products for which the components are manufactured in many locations ... Using electronic bidding assemblers get sub-assemblies up to 80 percent faster" (Gudmundsson and Walczuck 1999).

Internet impacts on the Manufacturing Flow Management process along all the supply chain. On one hand, Internet can have an impact on how a company manages the internal part of this process. For example, a company can implement an Internet-based production planning system to analyze the production requirements and plans of the different manufacturing facilities the company has. This system would improve the decision-making process of the production planners and sales personnel and would reduce the planning inaccuracies (Xiong, Tor et al. 2003). On the other hand, Internet can have an impact on how the operations of the whole supply chain are managed. It is perceived that the supply chain will change from an order-driven-lot-sizing approach to one more akin to a capacity-availability-booking approach supported by appropriate Internet search engines (Kehoe and Boughton 2001a).

Table 9 summarizes the literature review. (Kehoe and Boughton 2001a) and (Kehoe and Boughton 2001b) describe the impact of Internet on the management of the product flow through the manufacturing facilities along the supply chain. And, (Ko, Kim et al. 2001) and (Xiong, Tor et al. 2003) develop decision models to share knowledge along the supply chain in the manufacturing flow management.

Regarding the manufacturing planning and control systems, the academic challenges are to develop alternative business models, as well as to determine the tools and techniques by which the businesses' benefits of such models can be demonstrated to practitioners (Kehoe and Boughton 2001a). Further research should also be more empirically based. Finally, researchers should develop more decision models that take into account the global aspects of the supply chain to help to improve the manufacturing planning.

Table 9. Literature review: Manufacturing Flow Management process

Reference	Abstract	Methodology	Internet impact
(Kehoe and Boughton 2001b)	The Internet provides a real opportunity for demand data and supply capacity data to be visible to all companies within a manufacturing supply chain. Consequently, organizations have to explore alternative mechanisms for the manufacturing planning and control. The paper discusses the alignment of supply chain classification with the corresponding approaches adopted to operations planning and control in the light of the emerging Internet technologies. The work indicates that an alternative to the ERP approach can be developed by utilizing Internet partnering which offers the benefits associated with a more integrated approach to manufacturing planning and control across the supply chain.	Descriptive	Information sharing
(Kehoe and Boughton 2001a)	The paper discusses the role of the Internet within the manufacturing supply chain and, in particular, focuses on its impact on the manufacturing planning and control. Proposes the development of supply webs and a more interactive approach to supply chain partnering and identifies some of the research issues within this context to facilitate the development of Internet-based manufacturing planning and control.	Descriptive	Information sharing
(Ko, Kim et al. 2001)	The authors propose a design- and production-centered Virtual Manufacturing System, where collaborative manufacturing partners with surplus capacity can be chosen to accomplish the assigned task. They propose a mathematical model that minimizes both operation and transportation costs, and a tabu-search heuristic to solve the problem.	Decision models	Knowledge sharing
(Xiong, Tor et al. 2003)	This paper describes a web-enhanced dynamic BOM-based Available-To-Promise (ATP) system, which provides manufacturing companies with the ability to support the decision made by production planners and managers, independent of their locations. This information processing system indicates which amount of finished products can or cannot be produced at a specific time bucket according to the existing material availability. This system will improve the decision making process of production planners and sales personnel and reduce the planning inaccuracies.	Decision models * Case study	Knowledge sharing

6.6. The e-Procurement process

The Supplier Relationship Management consists on the process that relates a firm with its suppliers, and certainly it is a fundamental process in SCM. At the strategic level, the firm must define the corporate, manufacturing and sourcing strategies and identify the products and services that should be acquired from outside (Croxton, García-Dastugue et al. 2001). And, at the operational level, all the procurement activities, such as to review suppliers, to

identify opportunities, and to develop and implement product or service agreements, should be developed and controlled (Croxton, García-Dastugue et al. 2001).

The e-procurement process supports the procurement and sourcing activities via Internet technologies and enables an efficient negotiation between buyers and suppliers. We distinguish two types of e-procurement: B2B and marketplaces. By B2B e-procurement we consider the procurement and sourcing through Internet between two companies. Marketplaces are a multi-enterprise environment that enables customers and suppliers to announce buying and selling intentions, which can also be formalized in a buying or selling act and all related activities on real-time via Internet. Marketplaces bring multiple buyers and sellers together in a virtual market, meanwhile B2B e-procurement is a one to one relationship.

Since the procurement or supplier relationship process consists on a relationship between businesses and needs a large amount of information sharing and transfer, the use of Internet has had a big impact on this process. Several firms have implemented e-procurement solutions not only to reduce costs, but also to make more efficient this important process. The major impact of Internet on the procurement process is certainly the information sharing, since this process involves retrieving, sharing and storing a large amount of data and information. However, the knowledge sharing is becoming a key issue in this process. Firms can apply analytical models to previous data and obtain important information to make better decisions (Swaminathan and Tayur 2003).

Table 10 shows the literature review on e-procurement. The general aspects of how firms use Internet to streamline the process and which are the factors leading to a higher willingness to adopt Internet procurement, have been covered by empirical studies (see: (Boyer and Olson 2002), (Min and Galle 1999) and (Olson and Boyer 2003). (Peleg, Lee et al. 2002) provide some decision models to help managers take decisions regarding procurement strategies. The role and benefits of marketplaces have been covered extensively. Marketplaces have been described by (Emiliani 2000), (Emiliani and Stec 2002a), (Emiliani and Stec 2002b), (Gudmundsson and Walczuck 1999), (Kaplan and Sawhney 2000), (Mahadevan 2000) and (Wise and Morrison 2000); and empirically analyzed by (Hohner, Rich et al. 2003) and (Mahadevan 2003). Some authors, such as (Carr 2003) and (Lee and Whang 2002), have developed decision models for procurement alternatives using e-marketplaces. And, other authors, such as (Grieger 2003), (Kleindorfer and Wu 2003) and (Pinker, Seidmann et al. 2003), have conducted a literature review on marketplaces. On the other hand, B2B e-procurement has been covered by very few papers: (Calosso, Cantamessa et al. 2003) presents an internet platform for B2B procurement, while (Knudsen 2003), (Sparks and Wagner 2003) and (Tucker and Jones 2000) cover this topic from a descriptive point of view.

Table 10. Literature review: The e-Procurement process

Reference	Abstract	Methodology	Internet impact
(Boyer and Olson 2002)	This work presents a survey where the authors evaluate the ways firms utilize the Internet to streamline their purchasing process. The survey has examined 416 customers of a major Internet retailer of commodity office supplies. The main conclusion is that companies realize performance benefits from utilizing the Internet as a purchasing tool.	Survey	e-commerce Information sharing
(Calosso, Cantamessa et al. 2003)	The paper presents an Internet platform for business-to-business e-procurement process for small-and-medium enterprises with make-to-order operations. The authors examine in detail the structure of a standardized negotiation process occurring in a multi-enterprise setting and present three mixed-integer linear programming models that may be used by the different parties involved.	Decision models	Information and knowledge sharing
(Carr 2003)	The author presents an online auction model that extends previous models by considering service procurement auctions that end without achieving a contract despite active bidding.	Decision models	Information and knowledge sharing
(Emiliani 2000)	This work presents a comparison between online auctions and traditional procurement. The author evaluates the business-to-business online auctions for direct materials and discusses main organizational issues as price, cost and stakeholder reactions generated when online auctions are introduced to traditional purchasing organizations.	Descriptive	Information sharing
(Emiliani and Stec 2002a)	This work examines the use of online reverse auctions for the specific case of custom-designed machined parts. The authors also analyze the question "Why do managers use reverse auctions?".	Descriptive	Information sharing
(Emiliani and Stec 2002b)	The authors consider the online reverse auctions and examine if these ones are consistent with the Caux Round Table *Principles for Business*. They conclude that exists numerous inconsistencies and adverse outcomes, which have important implications for both economic theory and everyday business practices.	Descriptive	Information sharing
(Grieger 2003)	This work presents a literature review on Internet-based business-to-business marketplaces (EM), discussing the main aspects and calling for more supply chain management research within this field. The paper also describes how SCM for EMs can be examined by analyzing different types of EMs relationships (transactional, information-sharing, collaborative).	Literature review	Information sharing
(Gudmundsson and Walczuck 1999)	The authors evaluate the creation of a logistics electronic integrated marketplace system, and describe the effect of this one on the various aspects of the logistics industry. They also demonstrate how such marketplace could be developed and be successfully implemented using past and present systems. Finally they make some recommendations for managers.	Descriptive	Information sharing

Reference	Abstract	Methodology	Internet impact
(Hohner, Rich et al. 2003)	The authors describe a procurement auction web-based system, called Mars-IBM, that enables buyers to incorporate complex bid structures and business constraints into strategic-sourcing auctions. The system is based on solving the winner-determination problem, which can be formulated as an integer programming problem.	Case study * Decision models	Information and knowledge sharing
(Kaplan and Sawhney 2000)	The paper presents a description of how electronic hubs work and how they are crucial to creating a successful e-business strategy. The authors present a classification framework that provides an explanation of different e-hubs and how they add value.	Descriptive	Information sharing
(Kleindorfer and Wu 2003)	The authors present a literature review on exchange-based procurement in B2B markets and a general framework based on transaction cost economics. They use this framework to make a synthesis of the existing literature and to explain various types of contracting linked to B2B exchanges in capital-intensive industries.	Literature review * Decision models	Information and knowledge sharing
(Knudsen 2003)	The work presents a framework for assessing alignment between corporate strategy, procurement strategy and purchasing tools. The framework is built on generation of rent.	Descriptive	Information sharing
(Lee and Whang 2002)	This work presents an evaluation of the impact of an Internet secondary market where resellers can buy and sell excess inventories. The authors present a two-period model with a single manufacturer and many resellers. They also study potential strategies for the manufacturer to increase sales in the presence of the secondary market.	Decision models	Knowledge sharing
(Mahadevan 2000)	The author presents a framework that provides a means to understand how business models are designed for organizations in the Internet economy and allows for theory building. The framework is based on dividing the electronic market space into three broad structures: portals, market makers and product/service providers.	Descriptive	e-commerce
(Mahadevan 2003)	This work develops a classification scheme for B2B market structures that overcome limitations of previous research work. The author presents a study of 200 B2B sites in operation. The conclusion is that electronic markets fall under three distinctive categories: collaborative mechanism, quasi-market mechanism, and pure market mechanism. These mechanisms provide several value-creating opportunities.	Web scan	Information sharing
(Min and Galle 1999)	This paper investigates factors that influence purchasing professionals' willingness to adopt or utilize a cyber-purchasing system, while determining the most suitable cyber-purchasing strategy for a particular organizational setting.	Survey	e-commerce

Reference	Abstract	Methodology	Internet impact
(Olson and Boyer 2003)	This study analyzes how individual users' views and preferences affect the use of Internet as a purchasing medium. The authors present an exploratory study, based on clustering analysis of data gathered through a survey of 416 customers of a major Internet retailer of commodity office supplies.	Survey	e-commerce
(Peleg, Lee et al. 2002)	This work compares the three following procurement strategies with respect to the expected costs for the buyer: strategic partnership based on la long-term relationship with a single supplier; short-term strategy based on online search, and a combined strategy based on a combination of the previous strategies. The authors also present an analysis of how to determine the optimal number of suppliers to contact for a price quote for the last two strategies and how this value depends on the various costs and demand parameters.	Decision models	Information and knowledge sharing
(Pinker, Seidmann et al. 2003)	This work presents a literature review on the state-of-the-art research of management science applied to online auctions. It analyses the behavior of online auctions participants, the optimal design of online auctions, the integration of auctions into ongoing operations of firms, and the use of data generated by online auctions to inform future trading mechanisms.	Literature review	Information and knowledge sharing
(Sparks and Wagner 2003)	This work explores the impact of Internet-based retail exchanges on SCM, considering concepts such as Quick Response, Efficient Consumer Response and Collaborative Planning, Forecasting and Replenishment.	Descriptive	Information sharing
(Tucker and Jones 2000)	This paper raises awareness in the buyer/seller community of how intelligent agent software may be used to leverage the power of the Internet for optimal supplier sourcing. It shows that agent technology will be of most benefit when establishing short-term, adversarial buyer-supplier relationships. This paper also shows that agent technology does have an important role in partnership sourcing and will have maximum impact at the pre-negotiation stage.	Descriptive	Information sharing
(Wise and Morrison 2000)	The authors present a description of the B2B markets, by using the financial services industry as a window into the future of B2B. They examine the major trends that influence the strategies of both entrepreneurs and established companies and describe the key market players that are like to emerge and the roles they will play.	Descriptive	Information sharing

The e-procurement process is one of the most implemented and studied within the e-SCM literature. The above work has pointed out many new directions of future research. We will mention just some: more empirical studies on electronic marketplaces (Grieger 2003), more empirical and theoretical research on the behavior of participants in a e-procurement process and further research on the optimal design of this process (Pinker, Seidmann et al. 2003). We will also foresee more empirical and theoretical work on the collaborative

aspects of the e-procurement process, and further research on decision models to generate knowledge from the large amount of data generated by Internet.

6.7. *The Product Development and Commercialization process*

The Product Development and Commercialization process is critical to the success of the firm. It is the set of activities that companies should undertake to successfully develop and launch products. According to (Croxton, García-Dastugue et al. 2001), this process includes the following subprocesses or activities: to define new products, to establish the cross-functional product development team, to design and build prototypes, to determine the distribution channel for the new product and to measure the process performance. The process includes integrating customers and suppliers into the product development in order to launch the right product and to reduce the time to market. For example, Microsoft used a web collaboration tool to bring the Xbox video game console to market two months ahead of schedule (Keenan and Ante 2002).

What is the impact of Internet on this process? One of the most important impacts is to enable collaboration among different functional areas and companies. Internet-based product development can make product design a truly collaborative process among designers, manufacturers, suppliers and customers without the limitations of geographical location and time zone (Cheng, Pan et al. 2000). Taking the perspective of a focal company, we can distinguish between three types of effects: internal, downward and upward effects. Internal effects refer to the impact of Internet on the focal company. Internet enables the collaboration of different functional units in the new product development process. Downward effects refer to the impact of Internet on the relationships with customers: Internet facilitates the involvement of customers and/or end-users in the design of the new products, increasing the response of the company to the customer wants and needs. The company can also use Internet to consult customers to assess the market in a faster and cheaper way. And, the upward effects refer to the impact of Internet on the relationships with suppliers: Suppliers can be involved in the process as early as possible in order to reduce costs and compress the time to market.

Table 11 shows the results of our literature review regarding the Product Development and Commercialization process. The internal aspects were covered by (Xie, Tu et al. 2001) and (Xie, Tu et al. 2003), while the upward impacts by (Elliman and Orange 2000) and the downward ones by (Cheng, Pan et al. 2000) and (Finch 1999).

The existing studies have covered the areas of e-commerce, information sharing and knowledge sharing, and the upstream, internal and downstream perspectives. However, only one study, out of the six found, is empirically based. Further research should put more emphasis on conducting empirical studies in order to determine the real use and advantages of using Internet in the Product Development and Commercialization process.

Table 11. Literature review: The Product Development and Commercialization process

Reference	Abstract	Methodology	Internet impact
(Cheng, Pan et al. 2000)	The authors develop a web-based application which aim is to provide design/manufacturing expertise to customers. Manufacturing customers can rapidly access the system's built-in design and manufacturing expertise.	Decision models	Information and knowledge sharing
(Elliman and Orange 2000)	This paper proposes an electronic market for the design and supply capability in the construction industry. This would facilitate the selection of suppliers. The paper also discusses some of the research issues raised by such a prospect.	Descriptive	e-commerce Information sharing
(Finch 1999)	The objective of this study was to evaluate the potential of Internet discussions to provide detailed information about existing products. The results of these case study suggest that, for some companies, this information will be a valuable supplement to product design and quality conformance improvement efforts.	Case study	Information sharing
(Xie and Salvendy 2003)	The purpose of this study was to identify the major factors that affect the efficiency of engineering collaboration over the Internet. The authors developed a prototype of a CAD browser taking into account the features that enhance this efficiency: communication, coordination and collaboration awareness.	Decision models	Information and knowledge sharing
(Xie, Tu et al. 2001)	This paper presents a www-based integrated product development platform for intelligent concurrent design and manufacturing of sheet metal parts. It allows multiple designers to participate in the process despite they are located in different parts of the world. The system also allows the designer to understand the downstream process requirements (such as manufacturing requirements) and to design a product correctly in the first instance.	Decision models	Information and knowledge sharing
(Xie, Tu et al. 2003)	This paper reviews the existing systems for one-of-a-kind (OKP) products and the recent approaches of Internet-based design and manufacturing systems and discusses the requirements for the next generation of OKP systems.	Literature review	Information and knowledge sharing

6.8. *The Reverse Logistics & Returns process*

Effective returns management is a key process in today's business. This process includes all the elements in a supply chain, and a well designed process can create competitive advantage for the firm. The Reverse Logistics and Return process involves decisions on return avoidance practices, gatekeeping, disposition guidelines, development of a returns network and flow options (Croxton, García-Dastugue et al. 2001).

How can Internet help this process? Managing returns involves managing different types of data: reasons for return (defective, in warranty, old, etc.), conditions of the product, point of return, instructions to customers, etc. The major impact of Internet on this process

consists on providing better information and knowledge to all the elements of the supply chain involved in this process.

Another impact of Internet on the returns process is related with e-commerce. E-commerce generates more returns than the traditional commerce (Gentry 1999) and (Meyer 1999). Handling these returns efficiently is, without any question, an important issue for companies selling through Internet. Not only because the volume of returns is bigger in e-commerce than in the traditional channel, but also because the logistics involved are different. For example, in the traditional commerce, a customer that wants to return a product (within a few days of having bought it) he just has to go back to the store to return it. On the Internet channel this is different: How should the product be returned? Who should pay for this return? And, what should be the best supply chain structure to recover these products efficiently? It is not clear that the same structures as in the direct supply chain should be used. Designing efficient close-loop supply chains is a key element to improve the reverse logistics and returns process, and Internet can play an important role on this aspect.

Table 12 shows the literature review regarding this process. The existing papers cover both types of impact: sharing information through Internet and the returns of e-commerce sales. (Spengler and Schröter 2003) provide a case study to show how an Internet tool can be used to provide information to all elements of the supply chain involved in the returns process. And, (Vlachos and Dekker 2003) provide a mathematical model to better manage the returns for Internet sales.

Table 12. Literature review: The Reverse Logistics and Returns process

Reference	Abstract	Methodology	Internet impact
(Spengler and Schröter 2003)	An Internet-based tool is developed to provide an information and communication platform to all elements in the SC involved in the returns of Agfa-Gevaert's products. Afterwards, a strategic-planning tool based on system dynamics was developed to help decision makers to simulate and assess various production, recovery and material-recycling policies. This works shows how Internet, and in particular the information and knowledge management, can help to improve the returns process in a SC.	Case study * Decision models	Information and knowledge sharing
(Vlachos and Dekker 2003)	This work presents a mathematical model to help the decision maker to choose the best returns options for single period products. The model consists on an extension of the classical newsboy problem but it incorporates the returns, and it is particularly relevant for Internet sales. This work shows that this new commercial channel will lead to new and interesting problems, relevant to academia and business.	Decision models	e-commerce Knowledge sharing

In the next future, we expect the development of decision models to solve the problems related to the huge amount of returns associated with e-commerce. Some lines of research are: the dynamic estimation of expected demand of serviceable returns (Vlachos and Dekker 2003), inventory models considering returns, production planning including

recoverable parts and assemblies (Soto and Lourenço 2002), routing and distribution systems to handle returns, etc. Also, the possibility of sharing, through the web, information related to the returns puts more emphasis on developing analytical tools to help decision makers. More works like the one provided by (Spengler and Schröter 2003) are expected. Finally, researchers should also focus on the design of closed-loop supply chains that make use of Internet to manage efficiently the recovery of the return products.

6.9. Information flows

Under this heading we have classified all papers describing how information flows through the Internet. Although business-to-business electronic trading has been around for more than 20 years, using electronic data interchange (EDI) networks, the complexity of early EDI packages, rival standards and relatively high costs have traditionally excluded many companies, especially small firms (Kehoe and Boughton 2001b). The relatively easy access to Internet (most organizations have a telephone and a PC) makes this technology have a bigger impact on information flows than EDI.

The impact of Internet on information flows consists mainly on enabling companies to share information on real time. For years, ERP systems provided the ability to access information from various parts of the organization. However, their potential could not be explored and expanded due to a lack of common standards and cost of access. The growth of e-business enabled to share information, made available from ERP systems, with other supply chain members (Swaminathan and Tayur 2003).

This sharing of information affects all supply chain processes and some of its effects are: Inventory can be reduced due to better forecasts; the allocation of inventory in different retail outlets can be done more effectively; firms can use advanced planning and optimization tools because they have more information available; firms can implement collaborative planning and design; etc.

Table 13 summarizes the literature review. (Van Hoek 2001) describes the importance of the integrated flow of information along the supply chain in an e-business model. (Stefansson 2002) discusses how the advent of Internet opens up new perspectives for Small and Medium Enterprises (SME). (Bal, Wilding et al. 1999) describe how Internet enables the creation of virtual teams. (Mondal and Tiwari 2003), (Tatsiopoulos, Ponis et al. 2002) and (Yoo and Kim 2002) provide the development of data and/or knowledge management systems for sharing information and/or knowledge throughout the supply chain. (Wilson and Clarke 1998) describe how Internet can be used to collate, locate and disseminate traceability data. (Sarkis and Sundarraj 2002) and (Upton and McAfee 1996) cover the brokering situation of the virtual and e-commerce enabled organizations. And, finally, (Turowski 2002) describes how inter-company business processes can be integrated applying e-commerce techniques paired with agent technology.

Table 13. Literature review: Information flows

Reference	Abstract	Methodology	Internet impact
(Bal, Wilding et al. 1999)	This paper describes the information flows in the supply chain. Virtual teaming, enabled by Internet technologies, is presented as a tool for introducing agility in the supply chain. A virtual team, composed of technology, can improve the flow of information and quickly dampen turbulence through the ability of members to behave as a team, sharing knowledge and expertise, regardless of location. The paper presents the results of a case study and a survey.	Case study * Survey	Knowledge sharing
(Chan and Chung 2002)	The rapidly changing business environment is posing a challenge for SME (Small and Medium Enterprises) to transform its business processes for manufacturing in the information age. The paper, through a case study, exemplifies the use of a sophisticated information system to support contract manufacturing and a business model in the information age.	Case study	Knowledge sharing
(Mondal and Tiwari 2003)	In this paper, mobile computing is implemented by the use of a kernel programming language to coordinate efficiently and streamline the functionality of a supply chain in terms of data transaction.	Decision models * Case study	Information sharing
(Sarkis and Sundarraj 2002)	Interorganizational interactions are being transformed due to the adoption of the virtual enterprise. Automated electronic third party mediation (or brokering) mechanisms play an important role in this environment. The paper provides an analysis of the brokering situation of the e-commerce enabled organizations.	Descriptive	Knowledge sharing
(Stefansson 2002)	Information flows are crucial for carrying out an effective and efficient management of the supply chain. To support the flow of information different communication systems, such as EDI, exist for more than 30 years. However, the cost of its implementation places it out of reach of many SMEs. The paper discusses how the advent of Internet opens up new perspectives for this type of companies.	Case study	Information sharing
(Tatsiopoulos, Ponis et al. 2002)	This paper presents a methodology and a case study for SCM that makes extensive use of the virtual enterprise paradigm. The main research goal was to design and implement a prototype e-business software component and carry out several tests. The research effort resulted in an extended production data management system, which supported the business processes of customer order management, subcontractor selection and multi-site/ multi-firm production orders release.	Decision models * Case study	Information and knowledge sharing
(Turowski 2002)	The Internet has been created a tremendous opportunity to conduct business electronically. In this paper, an approach is proposed to support distributed, logically integrated inter-company business processes by applying e-commerce techniques paired with agent technology.	Descriptive	Information and knowledge sharing

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Reference	Abstract	Methodology	Internet impact
(Upton and McAfee 1996)	A virtual factory is a community of dozens, if not hundreds, of factories, each focused on what it does best, all linked by an electronic network that would enable them to operate responsibly and inexpensively regardless of their locations. This network is based on a continuous exchange of information. The authors state that two critical elements make this type of networked manufacturing community possible: the information broker and the open standards based on protocols established for the Internet. The paper describes the demands of a virtual factory, the current approaches (EDI, Groupware and Wide-Area Networks) and the information-brokered internetwork solution.	Descriptive	Information and knowledge sharing
(Van Hoek 2001)	This research note describes the role of the supply chain in an e-business model, and the importance of the integrated flow of information along the supply chain for strategic advantages.	Descriptive	Information sharing Efficient SC design
(Wilson and Clarke 1998)	This paper describes a possible mechanism for the design and development of a software system that will become the industry standard for the collation, location and dissemination of traceability data.	Descriptive	Information sharing
(Yoo and Kim 2002)	In this paper, a web-based knowledge management system is presented for facilitating seamless sharing of product data among application systems in virtual enterprises. That knowledge management system provides users with a map of product data that helps them to locate proper information, enables a content-based search that can improve search effectiveness, and supports automatic translation and reuse of product data among different application systems throughout the product life cycle.	Decision models	Information sharing

Most of the existing papers describe the impact of Internet on information flows or develop support systems to enable the sharing of information through the Internet. Very few papers are empirically-based, and the existing ones are case studies, which aim is to explore this impact on the real world. One line of further research should be to conduct surveys in order to generalize the findings. Some research objectives should be: To determine the level of adoption of virtual teams and to analyze what type of information are companies really sharing through Internet.

6.10. Supply chain relationships

SMC is "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole" (Christopher 1998).

In the traditional SCM, companies strategically segment their relationships and establish arm's length relationships with some supply chain members and strategic partnerships and

alliances with others. Internet has an impact on how companies manage all type of relationships. For the strategic partnership approach, Internet enables companies to share information and knowledge and to plan jointly, leading to higher levels of coordination and collaboration. And, for the arm's length approach, firms can benefit from the use of dynamic pricing structures that are web-enabled.

The existing papers are mainly descriptive. (Jap and Mohr 2002) stress the need to correctly match e-commerce strategies with the nature of organizational relationships. (O'Keefe 2001a) and (O'Keeffe 2001b) state that if a firm has not invested in the relationship with its suppliers, its ability to capture the full value of the Internet will be limited. (Williams, Esper et al. 2002) explores the impact of Internet on strategic alliances and partnerships. And, (Agarwal and Shankar 2003) identifies alternatives for trust development among buyer and supplier in the e-enabled supply chain. There is only one empirically based paper: (Golicic, Davis et al. 2002). This paper provides a case study which aim is to develop grounded theory of the impact of e-commerce on managing supply chain relationships.

Table 14. Literature review: Supply Chain Relationships

Reference	Abstract	Methodology	Internet impact
(Agarwal and Shankar 2003)	Trust is a binding force in most buyer-supplier transactions. The paper identifies alternatives for trust development among buyer and supplier in the e-enabled supply chain. In order to evaluate alternatives to evolve trust in an e-enabled supply chain, a framework involving analytic networked process is proposed. For the illustrative example, the results indicate superiority of a community responsibility system for building on-line trust along the e-enabled supply chain.	Decision models	
(Golicic, Davis et al. 2002)	The paper provides a qualitative study that was conducted with eight ecommerce companies in order to construct theoretical relationships with which develop grounded theory of the impact of ecommerce on managing supply chain relationships. The e-commerce environment was perceived as highly uncertain, stemming from increased information visibility and dynamic market structures. A stronger emphasis on relationship management as part of the business strategy enables managers to manage uncertainty better.	Case study	
(Jap and Mohr 2002)	The article describes how the B2B and emerging Internet technologies can be combined to (1) improve customer service, relationship quality and cooperation, and (2) decrease channel resistance. However, the authors state that Internet technologies cannot be successfully leveraged without considering the organizational relationships in which these technologies are being embedded. By correctly matching e-commerce strategies with the nature of organizational relationships, firms can improve their competitive position and profitability.	Descriptive	

Reference	Abstract	Methodology	Internet impact
(O'Keefe 2001a)	B2B e-commerce enhances the competitiveness of the firm by building relationship intangible assets (such as the capability of partnering). However, it has to be taken into account that if a firm has not invested in the relationship with its suppliers, its ability to capture the full value of the Internet will be limited.	Descriptive	
(O'Keeffe 2001b)	The author argues that the Internet does not signal the end of relationships nor level the playing filed for powerful buyers and traditionally weak sellers in the perishable food industries. The Internet and e-commerce are regarded by some as potential barriers to the continued development of vertical supply chain partnerships. The author states that the power of B2B e-commerce in the perishable food industries is based on unleashing the value of past investments in reputation and relationship assets.	Descriptive	
(Williams, Esper et al. 2002)	The purpose of this article is to shed light on the current and future organizational structures in the logistics industry as a result of the advent of the Internet and electronic communications. Toward that end, traditional Supply Chain Management, electronic Supply Chain Management and the resulting impact on strategic alliances and partnerships are explored.	Descriptive	

Further research should try to conduct more empirically-based studies in order to analyze which has been the real impact of Internet on the management of the supply chain relationships. Some lines of future research are: To examine in a greater depth (by extending the sample to a larger number of firms) the impact of e-commerce on relationships (Golicic, Davis et al. 2002) and to study it from a dyadic or a supply chain perspective (Golicic, Davis et al. 2002) examined it from a single-firm point of view); and to empirically test the relationship established by (Jap and Mohr 2002) between type of relationship (relational or transactional) and Internet efficiency (information sharing, increased reach and dynamic pricing).

6.11. Planning and Optimization

Planning and Optimization are key elements in SCM. Firms can use these techniques to anticipate problems and issues and, therefore, better respond to the needs of the customer. The availability of information and communication technologies, together with the last developments in the fields related to planning and optimization (Operations Research and statistics), have led to improvements in performance and the achievement of competitive advantages.

In this topic we have included the papers that apply Planning and Optimization to e-SCM and those other papers that review the work done in this area. Planning and Optimization in e-SCM is related to the Web application of decision technologies such as data management, statistical analysis, forecasting, data mining, optimization models, exact and

heuristic solution methods, simulation, economic models, game theory, etc. Nowadays many of these applications reside or are available through Application Service Providers (ASP). ASP are firms who host specific applications to be used by other companies on a fee basis. These services will be critical for small players, who cannot afford the major investments in infrastructure needed to participate in the collaborative supply chain.

Internet has had and will have a great impact on the development of decision technology. Firstly, it helps to improve the planning and optimization within the supply chain by providing access to decision support systems. And, secondly, the decision technology can take advantage of the ability to access an enormous quantity of data and information available through Internet.

Table 15 provides a summary of the literature review regarding this topic. Most of the papers use decision models as the main methodology and cover the impacts of information and knowledge sharing.

E-SCM is posing new and challenging problems that need to be solved. Therefore, there exists interesting opportunities for decision technology, OR models, optimization and economic theory to provide insights about planning and optimization in the e-supply chain.

We will also expect more developments on real-time tools, modeling and decision systems that use real-time data available through Internet. These will require solution techniques based on heuristics and approximation algorithms. Other important issues to be studied and developed are multi-criterion decision making, which can provide very interesting insights in the collaborative supply chain (due to the possible conflict of objectives when several firms interact in a supply chain and the models used to make decisions are based on incomplete information).

We will also expect more developments on Internet-based decision support systems and applications that use Internet to provide solutions and insights to the problems posed by e-SCM. By developing new planning, decision and optimization models and solution techniques, researchers will contribute to help managers to make better business decisions.

Finally, we also expect more real applications and case studies on the implementation of decision technologies using Internet.

Table 15. Literature review: Planning and Optimization

Reference	Abstract	Methodology	Internet impact
(Cohen, Kelly et al. 2001)	This work presents several Web-based applications of data management, statistical analysis, forecasting, data mining and operations research to several industries. These applications are optimization and decision support tools built via the Web. The case studies range from a large-scale production-and-distribution problem, to inventory replenishment problems.	Decision models * Case studies	Information and knowledge sharing
(Geoffrion and Krishnan 2001)	This work presents a general description of how Operations Research (OR) can contribute to the digital economy. The authors review applications and opportunities of four different areas: information goods and services, supply-chain management, network infrastructure and software tools for decision technologies.	Descriptive	Information and knowledge sharing
(Keskinocak and Tayur 2001)	The authors describe the impact of quantitative models on supporting companies on their decisions and on helping them to obtain insights for a better management of the supply chain. These techniques can have a significant impact on firms operating in Internet. Also, firms can use Internet technology to access the decision support needed.	Descriptive	Information and knowledge sharing
(Lee and Chen 2002)	This work presents a Web-based optimization tool to solve a complex and practical production-planning problem at BASF, a chemical manufacturer. The framework developed enables users with a Web browser to access this optimization tool and interactively compute optimal production plans on any computer platform.	Decision models * Case study	Knowledge sharing
(Shen, Kremer et al. 2003)	This work presents a Collaborative Agent System Architecture for implementing an agent-based Internet enabled collaborative supply chain management system. The authors also present a case study where they apply this system to a multi-plant production planning.	Decision models * Case study	Information and knowledge sharing
(Sodhi 2001)	The author describes how Operations Research can improve planning and execution in Internet-enabled supply chains. The opportunities for OR to develop applications in this area. The work refers to several supply chain processes from customer-relationship management to procurement, and describes the relationship between Internet-based OR applications and systems such as ERP and APS.	Descriptive	Information and knowledge sharing
(Swaminathan and Tayur 2003)	This work presents an overview of relevant analytical and operations research models applied to supply chain planning and execution. The authors discuss their contributions to several supply chain management areas, as for example, procurement and supplier selection, pricing and distribution, customization and postponement.	Literature review	Information and knowledge sharing

6.12. e-scm

Under this heading we have classified all the papers which aim is to analyze the impact of Internet on SCM. All these papers consider different supply chain processes.

Seven papers have been classified into this category. Three of them are descriptive: (Clarke 1998), (Graham and Hardaker 2000) and (Gunasekaran, H.B. Marri et al. 2002). (Clarke 1998) defines concepts for virtual logistics. (Graham and Hardaker 2000) describes the new competitive challenges being realized from the Internet. And, (Gunasekaran, H.B. Marri et al. 2002) define e-commerce and examine its application in manufacturing, retailing and service operations. Three papers are empirically-based: (Cagliano, Caniato et al. 2003), (Frohlich 2002) and (Frohlich and Westbrook 2002). (Cagliano, Caniato et al. 2003) explore the actual adoption of Internet technologies in supply chain processes by a large sample of European manufacturing firms. (Frohlich and Westbrook 2002) analyze the relationship between e-integration and performance and investigate the main barriers that impede integration. (Frohlich 2002) investigates the relationship between Internet-enabled supply chain integration strategies and performance in manufacturing and services. Finally, (Johnson and Whang 2002) examine how the web is changing SCM and classify the papers into three main categories: e-commerce, e-procurement and e-collaboration.

Our paper follows the same methodology as (Johnson and Whang 2002), but it differs from it in the following aspects. The main difference with our literature review is that we have reviewed more journals (they only reviewed 30 articles, while we have reviewed 85). Another difference is that they classified the papers only into three categories (e-commerce, e-procurement and e-collaboration), while we have classifie d them taking into account the eight supply chain processes identified by the International Center for Competitive Excellence (Lambert, Cooper et al. 1998) and some strategic aspects such as information flows, supply chain relationships and planning and optimization.

Table 16. Literature review: e-SCM

Reference	Abstract	Methodology	Internet impact
(Cagliano, Caniato et al. 2003)	The paper explores the actual adoption of Internet technologies in supply chain processes by a large sample of European manufacturing firms participating in the IMSS survey. The aim is to analyze the relationships among Internet adoption, contingent factors (such as industry, size and the position in the supply chain) and int egration mechanisms. Four e-business strategies are identified (traditional companies, e-sellers, e-purchasers and e-integrators) and their relationship with contingent factors and supply chain integration mechanisms are investigated. Results show a close link between the use of Internet tools and the level of integration with customers and suppliers, thus suggesting the need to define e-business strategies in coherence with the use of traditional integration mechanisms.	Survey	Information and knowledge sharing

Reference	Abstract	Methodology	Internet impact
(Frohlich and Westbrook 2002)	This paper empirically addresses two main research questions: (1) Is there a positive relationship between e-integration and performance? And (2) what are the main barriers that impede integration? E-integration is analyzed in different processes upstream (with suppliers) and downstream (with customers).	Survey	Information and knowledge sharing
(Frohlich 2002)	This paper investigated the relationship between Internet-enabled supply chain integration strategies and performance in manufacturing and services. The authors identify four web-based supply chain integration strategies: web-based low integration, web-based supply integration, web-based demand integration and web-based Demand Chain Management integration. The results of a survey showed that Demand Chain Management led to the highest performance in manufacturing.	Survey	Information and knowledge sharing
(Clarke 1998)	This article describes concepts for virtual logistics. With virtual logistics the physical and information aspects of logistics operations are treated independently. The author describes how Internet removes operating constraints and allows for a more efficient design of logistics networks.	Descriptive	Efficient SC design
(Graham and Hardaker 2000)	This paper deals with new competitive challenges being realized from the speed of growth of the Internet and the need to build commercially-viable supply chains to meet the challenges faced by the emerging virtual organizations.	Descriptive	Efficient SC design
(Gunasekaran, H.B. Marri et al. 2002)	The authors have attempted to define e-commerce and examine major e-commerce elements that link organizational systems. They examine the application of e-commerce in manufacturing, retailing and service operations, and propose a framework for describing e-commerce components and their role in different areas of an organization.	Descriptive	Information and knowledge sharing
(Johnson and Whang 2002)	In this paper, the authors examine how the web is changing SCM. They conduct a literature review on the impact of e-business on SCM and classify the work into three main categories: e-commerce, e-procurement and e-collaboration.	Literature review	Information and knowledge sharing

e-SCM is still in its early stages, thus requiring further investigation. As we can see in this subsection, further lines of research are needed in addition to the ones already pointed out in the previous pages, as for example: to develop real-time SCM models on product life-cycle management, dynamic pricing and production coordination; to conduct empirically-based analyses of the impact of Internet on different supply chain processes. (Cagliano, Caniato et al. 2003), (Frohlich and Westbrook 2002) and (Frohlich 2002) only considered some of them.

7. Conclusions

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 the methodologies used by researchers, the descriptive methodology has been the most used, followed by the empirical methodology and the decision models.

We expect that the number of research paper 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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