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Information flow in supply chain management: A review across the product lifecycle

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ABSTRACT

The purpose of this review is to provide an analysis and comparison of publications identified in the area of information flow in supply chain management. Although review articles have extensively analysed supply chain management during the manufacturing phase of the product lifecycle, product development and service phases seems to be largely separated. Therefore a total of 132 journal articles were systematically selected and analysed. In order to enable a methodological approach, a framework is proposed to classify the publications based on the product lifecycle phase and the type of the publication. Each phase of the product lifecycle is discussed in detail and research gaps are identified. Finally cross-phase research gaps are identified to provide guidelines for future research.

Introduction

During the last decade, supply chain management (SCM) has changed significantly due to globalisation and the pace of technological innovation. Competitive pressures have forced companies to increase supply chain collaboration throughout the whole product lifecycle. To improve their ability to integrate processes, businesses are also facing the challenge of shorter product lifecycles, globally dispersed design teams, a constant increase in outsourcing and the market demand for mass customisation. This has forced companies to create demand-driven and flexible supply chains that will be able to meet customers' expectations. Key business processes are integrated through the supply chain while strategic knowledge and issues are shared in order to achieve mutual benefits [1]. The integration of SCM systems has recently been under discussion in both information management and SCM literature. One of the main reasons that many researchers have highlighted the importance of information flow in supply chain is the continual increase in its complexity. Operating in this new complex environment, collaboration is no longer a theoretical concept but a key aspect of SCM [2].

SCM has become dependent on information flow as it can be characterised as the enabler of collaboration and improvement [3–5]. Significant improvements can be achieved by integrating the information flow through suppliers. OEMs can concentrate on the core activities of the product while using suppliers' additional resources, capabilities and skills to build lower cost and better quality products [6,7]. Often, suppliers have the capability, the knowledge and the expertise to develop better and more mature products. Bowersox and Calantone [8] state that even though collaboration in supply chain is not new, information advantages have only recently allowed companies to exchange more accurate and low-cost information. Information technology is only one element of the supply chain equation but it can be characterised as the enabler for improvements in global operations.

Whenever OEMs share their information and knowledge with suppliers, they allow their knowledge assets to become public and as a result risk their competitive edge [9]. Therefore, the level of integration into OEMs' processes and the depth of collaboration need to be defined. The level of information sharing is defined by Li et al. [10] as the extent to which critical and proprietary information is communicated to one's supply chain partner. During the last decade several researchers have focused on clustering the different types of relationships between suppliers. A classification of suppliers is key for OEM and Tier 1 companies as it will drive the type of connection required for each cluster of suppliers as well as reduce the number of suppliers required to become directly connected. Multiple types of categorisation have been proposed in the literature and can be used as a starting point for clustering suppliers and as a result reduce the cost in managing multiple types of relationships [7,11–15].

The evolution of technology and the Internet has allowed the development of web-based systems that can lead to improved

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collaboration within the supply chain. Within the manufacturing industry, digital systems are used daily to design, develop, produce, deliver and support products for global markets. However, the wide range of systems used, such as Computer Aided Design (CAD), Product Data Management (PDM), Enterprise Resource Planning (ERP), Product Lifecycle Management (PLM), has created the landscape of "Isolated Islands of Information" where information is locked in different repositories making it difficult to share. Although some of these systems allow the data exchange in a dynamic and direct way, organisations still need to work closely with suppliers to improve the decision making process and the entire supply chain performance [16,17].

During the last decade SCM has received significant attention, evidenced by the increasing number of publications in this area. Through these publications a number of definitions have been used to define SCM. Although the definitions provided by Lambert et al. [18] and Mentzer et al. [19] are most commonly referred to; in this review the definition from Swaminathan and Tayur [20] will be used as it is more appropriate for the specific aspect of SCM that this review focuses on. Swaminathan and Tayur [20] define SCM as the efficient management of the end-to-end process, which starts with the design of the product or service and ends when it has been consumed and discarded by the consumer. Information sharing within a supply chain is defined as the integration of information systems, decision systems, and business processes used to conduct information searches, manage business operations, monitor business details and perform other business activities [21].

While this field is widely researched, with several publications during the last decade, knowledge seems to be in silos residing in each phase of the product lifecycle. It is critical at this point to summarise and understand the work that has been completed in this field over the last decade in each stage of the product lifecycle in order to build in the previous work done instead of reinventing the wheel. The review of Power [22] focuses on SCM integration and implementation from a strategic perspective. Although Power follows a holistic approach, most of the examples and the use cases demonstrated focus on the manufacturing phase. Similarly, Pereira [4] reviews the current issues and trends in the IT-enabled SCM strategy using examples from manufacturing and logistics case studies. Burgess et al. [23] provide a systematic and structured review on SCM. Burgess et al. [23] highlight that SCM is relatively a "young" field with exponential growth in interest from researchers. Arshinder Kanda and Deshmukh [24] provide a systematic review with an emphasis on SC coordination. A framework is provided to support further research. The work of Marra et al. [25] explores IT enabled SCM from a knowledge management perspective. This review highlights the importance of measuring the impact of knowledge management in supply chain performance by directly relating IT adoption to the firm's growth. Helo and Szekely [26] examine the benefits of SCM that can be achieved through logistics information systems. This review paper demonstrates a software classification which includes applications that improve the information sharing in the manufacturing and service phase. Huang et al. [27] discuss the impact of information sharing in supply chain dynamics. This paper proposes a framework for categorising literature and research publications based on three key elements: supply chain structure, level of decision, and the production information model. Discussing mainly the information flow in the manufacturing phase and how suppliers exchange information such as capacity variances data, order data, lead times etc., this comprehensive review paper is a very good example of literature classification as it clearly shows the different types of information shared among the supply chain members as well as various modelling approaches used by researchers. Buyukozkan and Arsenyan [28] is the only review identified in this study that investigates the area of collaborative product development and provides future direction to support information flow during product development.

Even though these review papers highlight the importance of information sharing in SCM, there seems to be a gap in the literature discussing the product lifecycle from product development to manufacturing and service. Therefore, this review aims to address this gap by examining the area of information flow in SCM holistically including product development and service. The intent of this systematic review is to summarise and analyse the literature both in each phase of the product lifecycle and through cross-phase examinations in order to provide a better understanding of the current research gaps as well as provide directions for further research. This review can also be used as a starting point to guide new researchers entering the field. The following section presents the research methodology and an overview of the classification framework. Section three covers the analysis that was carried out in each phase of the product lifecycle while section four summarises the key findings for each part of the classification framework.

Review methodology

This review examines all publications between 2000 and 2012 that study the subject area of information flow in SCM. It is important to highlight that studies that examine either the information flow internally in organisations or the general literature of SCM are not included in this literature review. In addition, studies that discuss the subject area from high level without referring to a specific phase of the product lifecycle as also considered out of scope. Fig. 1 shows the selection and evaluation process that was taken in order to cover the whole product lifecycle.

Once the scope of the literature was defined, the selection process involved searching in the SCOPUS online database for peer-reviewed journal articles. From the SCOPUS database using two combinations of keywords, "supply chain" AND "information flow" and "supply chain" AND "information sharing", 1400 articles were identified. Through a filtering process the authors limited the search by excluding publications before the year 2000. In addition any conference papers, books and notes as well as publications that focus on subject areas outside of the research scope were also excluded from the analysis. As a result the total number was reduced to 676 publications. The abstracts from the first 200 most relevant papers were assessed in order to examine their fit with the scope of the research. As most of the articles identified at this stage

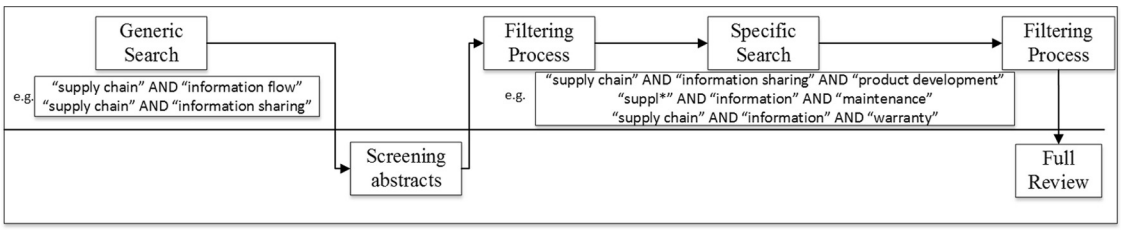

Fig. 1. Selection and evaluation process.