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Performance of supply chain collaboration – A simulation study

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ABSTRACT

In the past few decades several supply chain management initiatives such as Vendor Managed Inventory, Continuous Replenishment and Collaborative Planning Forecasting and Replenishment (CPFR) have been proposed in literature to improve the performance of supply chains. But, identifying the benefits of collaboration is still a big challenge for many supply chains. Confusion around the optimum number of partners, investment in collaboration and duration of partnership are some of the barriers of healthy collaborative arrangements. To evolve competitive supply chain collaboration (SCC), all SC processes need to be assessed from time to time for evaluating the performance. In a growing field, performance measurement is highly indispensable in order to make continuous improvement; in a new field, it is equally important to check the performance to test conduciveness of SCC. In this research, collaborative performance measurement will act as a testing tool to identify conducive environment to collaborate, by the way of pinpointing areas requiring improvements before initializing collaboration. We use actual industrial data and simulation to help managerial decision-making on the number of collaborating partners, the level of investments and the involvement in supply chain processes. This approach will help the supply chains to obtain maximum benefit of collaborative relationships. The use of simulation for understanding the performance of SCC is relatively a new approach and this can be used by companies that are interested in collaboration without having to invest a huge sum of money in establishing the actual collaboration.

1. Introduction

Supply chain management (SCM) organizes and manages the whole process of activities of supply network from suppliers through manufacturers, retailers/wholesales till end users (Christopher, 1998). Traditionally, supply chain (SC) was designed with more focus on movement of materials rather than information flow. Due to ever increasing competition in businesses, many SCs have taken some twists from traditional way of functioning, from time to time, to adapt to the situation. Existing literature describes the SCM of the 21st century as an integrative value adding process of planning and controlling of materials and information between the supplier and the end user in order to increase customer satisfaction by reduced cost and improved services (Cooper, Lamber, & Pagh, 1997).

In today's competitive unpredicted business world, cost reduction and good customer services are not stand-alone effort of any single SC member. As success of any product lies in customers' response to that product, it is important for businesses to achieve customer satisfaction by having efficient and effective SCs. This may be possible through collaboration among SC partners. Hence, it is important to coordinate SC activities to streamline planning, production and replenishment (Ramanathan, 2013). Market demand and changing nature of end-users can create more opportunities for SC players. At the same time, to be viable in a competitive market, all SC members need to be innovative and productive (Lee, 2002). As operating alone in a tight competition seem to be no longer beneficial for SCs, the importance of partnership has been adopted in various stages of many SCs (Smaros, 2007).

In the past, several SCM practices such as Vendor Managed Inventory (VMI), Efficient Consumer Response (ECR), Continuous Replenishment (CR), and Electronic Data Interchange (EDI) have been suggested in the literature to increase benefits of SCs. VMI technique was developed in the mid 1980's, in which customer's inventory policy and replenishment process were managed by the manufacturer or supplier. However, SC visibility was not predominately powerful in VMI to avoid bullwhip effect (Barratt & Oliveira, 2001). Forecast driven VMI and integration of CR with EDI was used to reduce the information distortion in VMI. ECR developed in 1992, was based on the concept of value adding by all partners in the supply chain. Both VMI and EDI together with ECR tried to create more responsive supply chain with broader visibility of information across the whole SC. Ever increasing SC demands have led to the invention of Collaborative Planning Forecasting and Replenishment (CPFR), another supply chain management tool

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incorporating planning, forecasting and replenishment under a single framework (Fliedner, 2003). CPFR, a second generation ECR (Seifert, 2003) aims to be responsive to consumer demand. It was introduced as a pilot project between Wal-Mart and Warner-Lambert in mid-nineties. According to VICS (2002), CPFR is a new collaborative business perspective that combines the intelligence of multiple trading partners in the planning and fulfilment of customers demand by linking sales and marketing best practices.

Collaboration among SC members is a topic of interest for many researchers and practitioners (Barratt & Oliveira, 2001; Danese, 2007; Nyaga, Whipple, & Lynch, 2010; Ramanathan, 2013). Simatupang and Sridharan (2004) evolved four profiles for supply chain collaboration (SCC), namely efficient, synergistic, underrating and prospective collaboration. They proposed decision synchronization, incentive alignment and information sharing as three performance indices. In an attempt to maximize benefits of SCs, all SC members share information (data sharing) and collectively forecast the demand for products to have effective replenishment process (Aviv, 2007; Gavirneni, Kapuscinski, & Tayur, 1999). SCC activities help to improve the performance of involved members in a structured framework with the aim of maximizing profit through improved logistical services (Stank, Keller, & Daugherty, 2001). However, majority of the articles in the literature have not highlighted important factors of good SCC practice. In this paper, we will be analysing the environments conducive to initiate SCC such as CPFR. The focus of this research is to identify the suitable environments to collaborate in SCs. Revealing the actual benefits of SC collaboration with certain number of partners with specific level of investments for a specified period will help to make decision on implementing SCC at various levels. This is further explained through evidence from the existing literature in the next section.

The rest of the paper is organised as follows: Section 2 will briefly explain the existing literature on SCC. Section 3 will describe research methodology used in this research. Section 4 explains the development of performance measurement of supply chain collaboration. Section 5 will discuss the results and analysis of simulation. Finally, Section 6 will conclude the paper with key findings, managerial implications, limitations and future work.

2. Supply chain collaboration for performance improvement: a literature review

SCM is being practiced by many businesses around the globe and hence it has a great wealth of literature from time of evolution of business processes. But, SCC is a relatively new research area and the literature is growing at a tremendous pace. Various advantages and disadvantages have been revealed by academics and practitioners. This section discusses some of the advantages and barriers of SCC. On realizing the importance of collaborative efforts in SCs, many researchers have developed theoretical and mathematical models to improve the structure and functionality of SCs.

2.1. Advantages of SC collaboration

In the field of SCM, there is an overlap in the meaning of cooperation, coordination, collaboration, joint action plan and partnership, representing more or less the same concept (Corsten & Felde 2005; Yu, Yan, & Cheng, 2001). However, CPFR is specifically defined as a web-based attempt (Fliedner, 2003) or internet tool to coordinate the various supply chain activities such as forecasting, production and purchasing in SCs to improve the visibility of consumer demand (Barratt & Oliveira, 2001), to reduce any variance between supply and demand (Steermann, 2003). Caridi, Cigolini, and Marco (2005) viewed CPFR as a process of correcting, adjusting, proposing prices and quantities to reach an agreement on common unique forecast that can be used by buyers and sellers. VICS (2002) claimed that CPFR would help cost savings and gain competitive advantage. Several case studies have been reported in literatures that have examined the impact of collaboration (see www.ecch.com and ECR, 2002).

In SCCs, through joint planning and decision making, the understanding of the replenishment process is becoming clearer (Barratt & Oliveira, 2001). For example, Wal-Mart's initiative of creating profile on purchase pattern of customers, namely 'personality traits', has helped to increase visibility of demand throughout the value chain (McIvor et al., 2003). Information exchange and demand forecast based on sales data helped 'Sport Obermeyer' to improve forecast accuracy during demand uncertainty (Fisher 1997).

In recent years, many academics and practitioners have suggested using collaborative arrangement to improve SC performance. Ramanathan and Muyldermans (2011) used structural equation models to identify underlying demand factors of soft drink sales in collaborative supply chains. They suggested using those factors for demand forecasting. Cheung, Cheung, and Kwok (2012) used actionable quantitative information from a number of upstream and downstream partners in developing knowledge-based system in supply chains. They have used simulation experiments to test SC models. Ramanathan and Gunasekaran (2013), Nyaga et al. (2010) and several other researchers insisted the importance of transparent information sharing, joint efforts and investments to improve trust and commitments in SCCs.

Any SC can improve visibility using five important factors namely responsiveness, planning, shared targets, trust and common forecast (Barratt & Oliveira 2001). Real benefit of information sharing among SC partners lies in its effective and efficient use (Lee, So, & Tang, 2000; Raghunathan, 2001) and it is also supported by proper use of Information Technology (IT) (Cachon & Fisher, 2000; Sanders & Premus, 2005). From the cases of Wal-mart and P&G, it is understandable that the use of various IT platforms is based on the scale of operations.

2.2. Barriers of SC collaboration

Barriers of SC collaboration can be broadly classified under two categories: organisational and operational. Smaros (2007) argued that lack of internal integration (organisational barrier) would be a great obstacle for manufacturers to efficiently use demand and forecast information (operational barrier). Sometimes behavioural issues within organisation may also lead to failure of collaborative relationships. Fliedner (2003) considered lack of trust, lack of internal forecast, and fear of collusion as three main obstacles to implement collaboration. Boddy, Cahill, Charles, Fraser-Kraus, and MacBeth (1998) identified six underlying barriers for partnering: insufficient focus on the long term, improper definition of cost and benefit, over reliance on relations, conflicts on priority, underestimating the scale of change and turbulence surrounding partnering.

Use of technology and levels of information exchange in SCs have been discussed in the literature as both the advantage and the disadvantage (Cadilhon & Fearne, 2005; Sanders & Premus 2005; Smaros, 2007). Occasionally, even a basic level of information exchange will yield potential benefits to businesses. For example, Metro Cash & Carry Vietnam is a German-owned business to business grocery wholesaler successfully engaged in collaboration with a disarming degree of simplicity. The company shares information among SC partners using telephone calls and fax machine without much sophisticated IT (Cadilhon & Fearne, 2005). The case of Metro Cash & Carry clarifies that free access to available data is imminent in SCCs for planning and forecasting. But technology may not be a barrier for the success of collaboration (Cadilhon & Fearne, 2005; Smaros, 2007). This argument on technology totally