Collaboration and its impact on Supply Chain Dynamics

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Abstract

In the past decade companies have realized that although their focus on consumer satisfaction has been important in achieving in-house innovation, their competitiveness and profitability have not improved considerably. A primary reason for this is that independent inventory management decisions are made by supply chain partners. Businesses have now realized that collaboration among trading firms is a more effective process to deal with issues related to inventory management, as compared to the customary approach of shifting the load of inventories. This research demonstrates, through a dynamic simulation approach, the positive performance outcomes of collaboration such as increased sales, improved profits, reduced inventory levels, reduced lost sales and improved order fill rates.

Keywords

Collaboration, CPFR, Supply Chain Dynamics, Continuous Simulation

1. Introduction

In recent years companies have realized that cost reduction opportunities in manufacturing processes have diminished and thus there is a need to effectively manage respective supply chains to improve competitiveness and profitability in organizations. Managers in firms now understand that their actions can severely influence other partners in the value network. Integration and efficient organization of supply chains have become a necessity in order to increase consumer satisfaction. The major challenge ahead for companies is to change their focus from individual based improvements to inter-firm coordination [1].

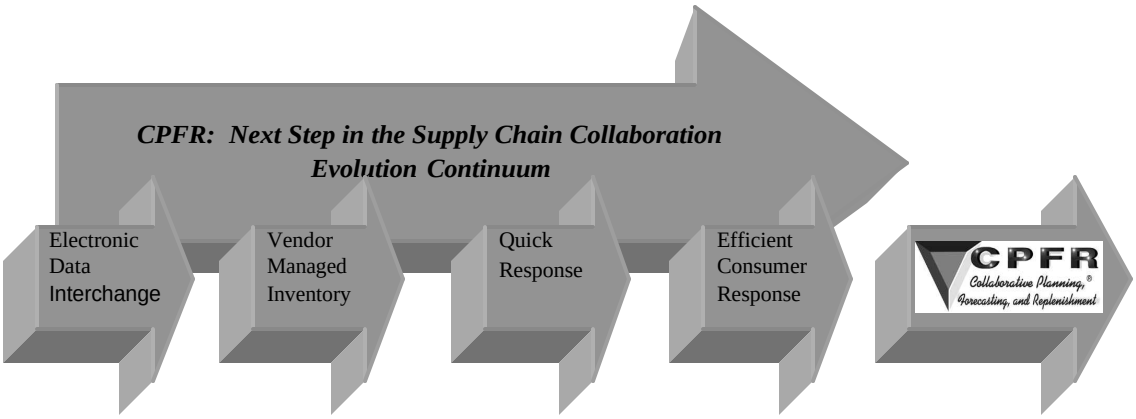
There has been a paradigm shift in the traditional approach of delivering products based on uncertain demand projections resulting in unprecedented high levels of finished goods inventory in the different echelons. Under the new approach, companies have acknowledged the importance of closer coordination among members of a supply chain to deliver products on time, in exact quantities and with the desired quality. Supply chain collaboration is an approach that leads to increased information flows, lower level of uncertainty and ultimately more profitable and efficient supply chain [2].

2. Literature Review

Collaboration is a method of enhancing inter-enterprise as well as intra-enterprise synchronization of information that makes it a business imperative. It implies sharing of data, information, forecasts, and functions or mix of all the above with a goal of creating a win-win situation for all the members of a supply chain. It is not a novel business approach or a paradigm shift as companies at times have been exchanging information and product data with their trading partners. The firms have been using systems that deal with specific business issues addressed from diverse domains such as customer relationship management (CRM), enterprise resource planning (ERP) and advanced planning and scheduling (APS) [3].

Over the past one-decade, the collaboration techniques have been applied through various policies, i.e. Horizontal and Vertical Integration, EDI (Electronic Data Interchange), VMI (Vendor Managed Inventory), QR (Quick response), ECR (Efficient consumer response), CM (Category Management) and CR (Continuous Replenishment)

(Refer to Figure 1 for the pictorial presentation). Each of these policies deals with different aspects of the supply chain.



Source: Adapted from Industry Directions Inc., and Syncra Systems, Inc. 2000 [4]

Figure 1: CPFR - Next Step in the Supply Chain Collaboration Evaluation Continuum

Collaborative Planning Forecasting and Replenishment (CPFR) is an approach that has been developed from the above collaborative techniques that focus on integration of supply and demand planning, and addresses some of the drawbacks of past initiatives such as individual forecasting. Further, the previous techniques gave more importance to financial planning rather than focusing on improving forecasting that resulted in higher inventories, lower fill rates and increased costs across the supply chain. The goal is to reduce waste and compete as an integrated system [5].

3. Methodology and Operating Environment

The approach used in this research is based on the system dynamics approach devised by Forrester [6]. System dynamics is the study of how systems change over time. The system dynamics methodology is concerned with creating a computer model of the system under study, examining the interaction of individual components of a system including their relationship with one another and observing the effects of introducing various changes into the system. It is an integrated approach that offers a set of tools and techniques to conceptualize and represent models of organizational systems, test their validity through simulation, and analyze operational, tactical, and strategic issues (Figure 2). The underlying structure of the system is examined to understand the cause and effect relationships that may be produced within the system. Simulation provides a way to understand the behavior arising from a particular system structure. Although, the scope and applications of system dynamics have changed over the years, some of its basic characteristics still remain the same [7].

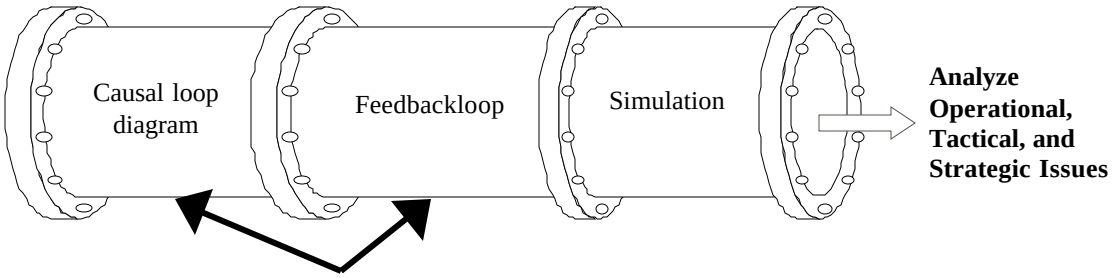


Figure 2: System Dynamics Approach [8]

The model comprising of a supplier, a distributor and a retailer represents the 3-Echelon supply chain model as a baseline model for the research. It is based on the traditional inventory management principles. In this scenario, the upstream partner (supplier) receives information (orders) from distributor, and sets its production policy accordingly. Similarly, the retailer places orders to and receives items from the distributor. The traditional inventory

management (TIM) model was modified to observe the effect of introducing the concept of CPFR in the existing supply chain and was tested under varying demand conditions such as Random (low variance), Pulse, Ramp, Random (high variance), Random Cyclic with Periodic Pulse, Quarterly Push, Fast Moving and Seasonal Demand.

The environment is similar to an Automotive Service Parts Supply Chain. The retailer in a consumer goods supply chain is analogous to an OEM (Original Equipments Manufacturer) dealer such as a Toyota authorized dealer that stores a variety of service parts for various automotive segments (Compact, Mid-size, Full size, SUV's, and Minivan). Auto dealers normally lie at the end of a complex automotive supply chain that carries thousands of part numbers, ranging from small nuts to big transmissions and engines. Since dealers cannot possibly keep everything in stock, efficient service parts management is essential to lower the inventory costs and to keep high service levels. Similarly, a distributor in a traditional supply chain is similar to a parts distribution center (PDC) that supplies goods to the dealers in respective region. In general operation for critical orders, the PDC can provide same-day delivery to dealers. Other items may arrive as weekly or biweekly stock orders. A redistribution center (RDC) supplies parts to PDC and carries much more inventory than a PDC

4. Results

The simulation results revealed that the performance of collaboration based supply chain (CPFR) model was superior to that of traditional inventory management (TIM) model under all the demand patterns except when exposed to demands with high variance. By far the greatest gains were realized under seasonal demand. Figure 3 shows how collaboration affected on hand inventory level at the individual echelon level (Retailer (Dealer), Distributor (PDC) and Supplier (RDC)) under the influence of seasonal demand pattern.

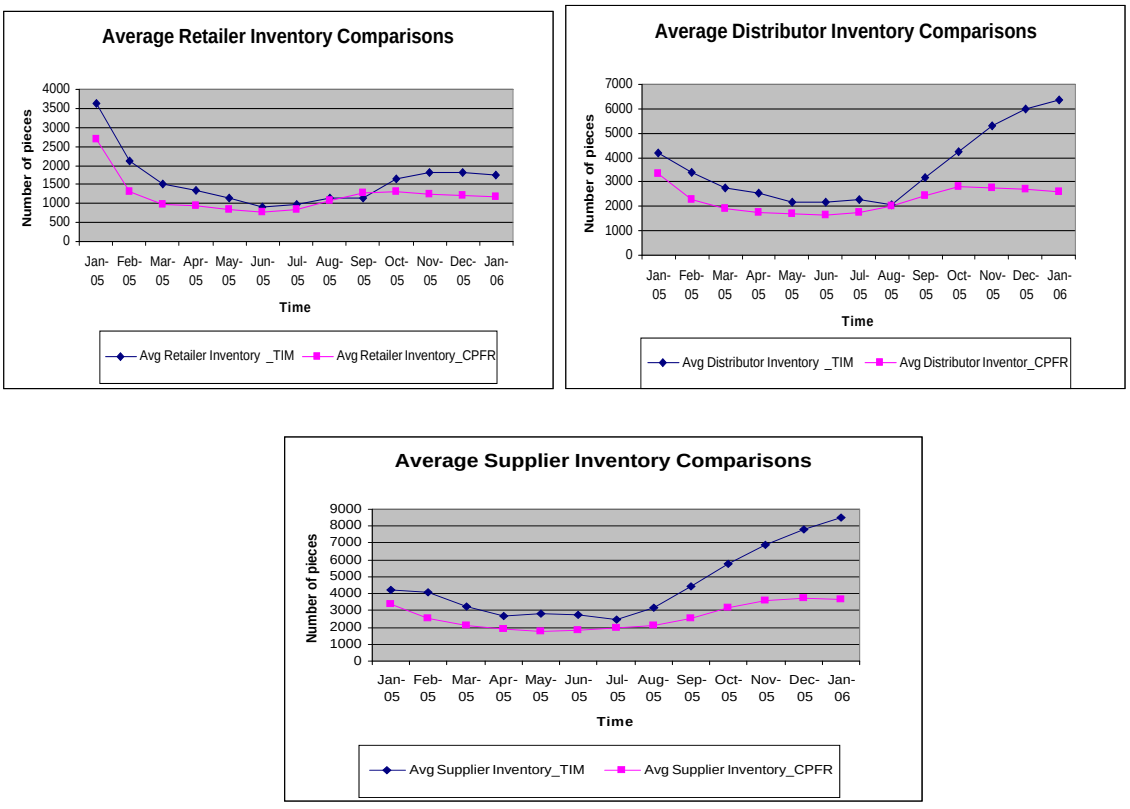


Figure 3: Average Inventory Comparisons (TIM and CPFR)

The above results clearly supported that CPFR reduces inventory levels across the supply chain. The maximum average inventory drop at the retailer level (seasonal demand) was 32%, the distributor level around 59% and the supplier level at 57%. A common forecast helped in mitigating the bullwhip effect that resulted in lower inventory across the supply chain. These reductions in the inventory levels were direct result of faster transmission of information by making the best use of POS information.

Out of stock situations were reduced as a result of CPFR implementation that in turn enhanced the sales growth. The sales volume was further increased through improvement of service. Collaboration also resulted in reduced distribution space and labor costs. Reduced inventories mean lower capital, handling and other related costs. The reduction in total costs and increase in sales enhanced the profitability of the supply chain. The retailer under Ramp Demand experienced sales increases of 28%, the distributor around 42% and the supplier 50%. The supplier under Seasonal Demand observed highest increase in profitability (% change in $) of 66%, the distributor 62%, and the retailer around 42%. These results indicated that CPFR results in improved sales and increases the profitability of members involved in collaboration. Improved visibility of the supply chain due to real time sharing of information also increased the reliability of supplies and in turn improved the product availability. Maximum gains from CPFR in terms of service enhancement were achieved under the ramp demand. The retailer's average order fill rate was increased by 12%, the distributor's around 13% and the supplier around 18%. The above results also indicated that the supplier or the upstream echelons benefit more from the collaboration gains than the Retailer.

5. Conclusions & Future Research

The results of this study support that collaboration significantly improves the performance of the supply chain in terms of all the selected performance measures. In short, collaboration adds value to the supply chain by reducing the average inventory, increasing total sales, decreasing the amount of lost sales, and by enhancing the profitability and service levels at the individual echelon level. In general, the upstream members of the supply chain (Distributor and Supplier) gain more from the collaboration process than the Retailer. However, the benefits to individual echelons in the supply chain are different under different operating conditions. The most significant performance improvements for all the echelons were realized under seasonal and ramp demand patterns. Although much of the past research related to Collaboration initiatives such as CPFR had been in consumer goods industries, the results of this study indicate that CPFR can have a significant impact in certain industries that experiences seasonal demand such as Hotels and Tourism.

The simulation and experimental analysis revealed some very significant results that will need further investigation. Although, the performance of supply chain under CPFR scenario outperformed the traditional inventory management environment under most of the demand patterns, exceptions from other results were observed demands with very high variance. Although the observations seem to be not statistically significant (judgmental as t-tests could not be performed due to one replication), and were relatively minor, future research in the area can further investigate this change in behavior. These observations also suggests that Collaboration based model such as CPFR is not one size fit for all the products or types of businesses and it is essential for any firm involved in collaboration to categorize its line of products based on nature of demand before implementing any collaboration based approach.

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