Available online at www.sciencedirect.com
SCIENCE DIRECT®
Int. J. Production Economics 103 (2006) 420–437
international journal of production economics
www.elsevier.com/locate/ijpe

The impact of information sharing and forecasting in capacitated industrial supply chains: A case study

P.J. Byrne*, Cathal Heavey

Department of Manufacturing & Operations Engineering, University of Limerick, Ireland

Received 22 July 2004; accepted 20 October 2005
Available online 20 February 2006

Abstract

This paper models and analyses the effect of information sharing and forecasting on the performance parameters of an actual industrial supply chain consisting of Small-To-Medium sized enterprises. The paper reports on the industrial supply chain studied, which was undergoing a Business Process Re-engineering (BPR) exercise. The aim of the BPR exercise was the streamlining of existing unstructured processes, ultimately culminating in the introduction of an ERP system into the organisation to improve information sharing between the supply chains echelons.

The paper reviews previous work in this area and expands this work to address the issues posed by a more complex real industrial example. The model itself has been developed for a complex supply chain structure. This supply chain has multiple customers, distributors and product families, with customers and distributors face differing demand patterns.

This model and its associated experimentation highlights the significant benefits achievable through the use of improved information sharing and forecasting techniques on the supply chain performance parameters. Potential total supply chain cost savings of up to 9.7% have been shown, with increased savings occurring with reduced system capacity. The model also quantifies the impact of collaboration between all partners in the study and shows that gains are achievable by all parties in the supply chain.

Keywords: Supply chain; Business process re-engineering (BPR); Discrete event simulation; Decision support system

1. Introduction

Supply Chain Management (SCM) is made up of the control of both material and information flow among suppliers, manufacturers, distributors and customers. SCM involves the management of these flows both within and between companies and organisations. However, to coordinate the supply chain, it is necessary for these supply chain partners to share information. It is widely recognised that advances in technologies in the areas of information, manufacturing, and distribution systems have driven much change through the supply chain and logistics management services. This has particularly been the case with improving information technology enabling instantaneous global information sharing with more powerful information processing. Traditionally, the management of information has been somewhat neglected. The method of information transfer and forecasts carried out by members

*Corresponding author. Tel.: +353 61 202948.
E-mail addresses: pj.byrne@ul.ie (P.J. Byrne), cathal.heavey@ul.ie (C. Heavey).

0925-5273/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.ijpe.2005.10.007

of the supply chain consisted of placing orders to the member directly above them, termed their preceding 'echelon'. This causes many problems in the supply chain. These included excessive inventory holding and shortages, increased lead times and reduced service levels. In addition, increased demand variability or the 'Bullwhip Effect', compounded forecasting problems and led to difficulties in echelons further up the supply chain.

Thus, as SCM progresses, supply chain managers are realising the need for utilising improved information sharing and forecasting throughout the supply chain in order to remain competitive. This is because companies increasingly operate and compete in an ever-expanding global economy. It is widely recognised from studies in the area that improving information sharing, forecasting and general supply chain collaboration will lead to supply chain gains. For some recent papers advocating these points the interested reader is referred to the following: Yao et al. (2005), Holweg et al. (2005), Lee et al. (2000), Kelle and Akbulut (2005), Chandra and Grabis (2005) and Liberopoulous and Koukoumialos (2005) However, Raghunathan (2001), has suggested that the study by Lee et al. (2000) overestimates the benefit of demand information sharing by the retailer in the two-level supply chain studied. They suggest that the reason for the overestimation is the assumption that the manufacturer uses only the current period's retailer order quantity to forecast that of the next period. However, they do accept that information sharing is useful in this model when there is an element of demand which cannot be predicted by the manufacturer using order history. Things such as promotions, price reductions and advertisements by the retailer can cause these demand uncertainties. Many of the studies found in the literature have analysed simplified supply chains using, in the majority of cases, analytical techniques. While analytical models are computationally efficient, they tend to be highly modified versions of reality in order for them to be tractable. Such models can be envisaged as being restrictive in an industrial setting and are therefore only useful to gain simple insights. For such studies to be of real industrial use, they must have the ability to incorporate the details found in today's detailed supply networks and have the flexibility to change within a changing environment. In other words, such models should be reusable and adaptable by operational personnel on an ongoing basis.

The purpose of this study is to explore the effect of utilising information sharing and forecasting in a capacitated supply chain, where minimal forecasting and information had been shared in the past. The model developed is that of a real industrial supply chain, with multiple products and multiple echelons with significant product interactions. In this paper, we consider two information sharing strategies, two forecasting techniques and three capacity levels that were being examined by the case study company in question. In order to model the situation in detail, a computer simulation model of the supply chain has been developed. The aim of this study is to expand existing theoretical studies to include a real-life complex case study in an attempt to provide practitioners with realistic expected performance improvements consequent on initiatives.

The next section reviews the related literature. Section 3 formulates the problem and outlines the model. Section 4 details a numerical study with experimentation on information sharing, forecasting and capacity constraints and Section 5 discusses the results and concludes.

2. Literature review

With the advent of improved computing power and the application of modern information technologies, such as Electronics Data Interchange through integrated systems and the Internet, companies have the ability to share information seamlessly (Strader et al., 1999). With information stored in a data warehouse it can be advantageous to use decision support systems, which will help the users apply analytical and scientific methods to decision making (Bhargava et al., 1999). However, on the other hand, caution should be exercised as Raman et al. (2001) state, "we've been promised a world of supply chain management, one free of stock-outs and overstocked warehouses. But inaccurate data is sabotaging this vision."

The value of such information sharing in supply chains is an area which has been studied extensively in the literature. For an overview of the complete area, the following two papers are well-rounded reviews on the subject: Lee and Whang (2000) and Huang et al. (2003). The simplest of these systems is the study of a dyadic supply chain where there are only two echelons, usually a supplier and a retailer/customer. Because of the simplicity of such systems it is easy to understand and monitor. Examples of papers studying such systems start with Clark and