INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI®

Bell & Howell Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

INFORMATION EXCHANGE IN A SUPPLY CHAIN: AN EMPIRICAL INVESTIGATION

by

John R. Olson

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Business
(Management)

Under the Supervision of Professor Marc J. Schniederjans

Lincoln, Nebraska

August, 1999

DISSERTATION TITLE

Information Exchange in a Supply Chain:

An Empirical Investigation

BY

John R. Olson

SUPERVISORY COMMITTEE:

	APPROVED	DATE
Signature	Marc J. Schniederjans	8/19/99
Typed Name	Marc J. Schniederjans (Ph.D.)	
Signature	Lester A. Digman	8/19/99
Typed Name	Lester A. Digman (Ph.D.)	
Signature	Fred Choobineh	8/19/99
Typed Name	Fred Choobineh (Ph.D.)	
Signature	Paul A. Savory	8/19/99
Typed Name	Paul A. Savory (Ph.D.)	
Signature		
Typed Name		
Signature		
Typed Name		

GRADUATE COLLEGE
UNIVERSITY OF NEBRASKA

INFORMATION EXCHANGE IN A SUPPLY CHAIN: AN EMPIRICAL INVESTIGATION

John R. Olson, Ph.D.

University of Nebraska, 1999

Advisor: Marc J. Schniederjans

Entering the 21st century, organizations must consider the issues of increased competition, rising customer expectations and the demand for increased product variety to remain competitive. Other issues a firm must account for include decreased profit margins and stricter governmental controls like tariffs. To handle these pressures organizations are forced to consider the impact of operational decisions on not only their immediate company but also all members of their supply chain. The competition of the future will not be organization to organization, but rather supply chain to supply chain.

Since the invention of Just-in-Time, supply chain partners have used information technology tools such as electronic data interchange (EDI) to exchange key pieces of information across companies. However, the success of these practices have been mixed, some firms have found remarkable success while others very little or no success. Many reasons exist that limit the success of these systems; two primary reasons are the cost prohibitive nature of EDI systems and failure of companies to modify their processes. This dissertation explores the impact of information technology and reengineering practices on supply chain performance.

The results of the study indicate that successful supply chain reengineering efforts will positively impact supply chain performance. Supply chains that use either EDI or Internet systems to share data will achieve higher levels of performance when

reengineering the supply chain. In addition, there are several organizational enablers that impact the overall success of the supply chain reengineering effort. Top management support, centralized decision making, positive organizational culture, resource management and human resource enablers were positively associated with successful supply chain reengineering efforts while resistance was negatively associated with successful supply chain reengineering efforts.

Acknowledgements

I wish to thank my advisor Dr. Marc J. Schniederjans, for not only his guidance and assistance in this study, but demonstrating by example how to be a professional. His hard work and dedication serves as my model of how to be excellent scholar.

I would also like to thank the other members of my committee, Dr. Lester Digman and Dr. Fred Choobineh for their input and advice. Your doors were never closed when I had a question to ask.

A very special thank you goes to Dr. Paul Savory for not only serving on my committee, but also showing me what it takes to be a great instructor and productive scholar. Through our various projects and experiences I have learned how to organize my work and stay focused towards achieving my goals.

I would also like to thank Dr. Sang Lee for his career guidance. Other people include all of my cohorts in the Ph.D. program. This would not be complete if I did not thank Julie and all of my family for all of their support and encouragement.

Dedication

This work is dedicated to my parents Adolph M. Olson and Donna A. Olson. Without your love, help and support this would have never been possible. I love you both.

Table of Contents

List of Tables

List of Figures

CHAPTER I

INTRODUCTION

1.1 Overview

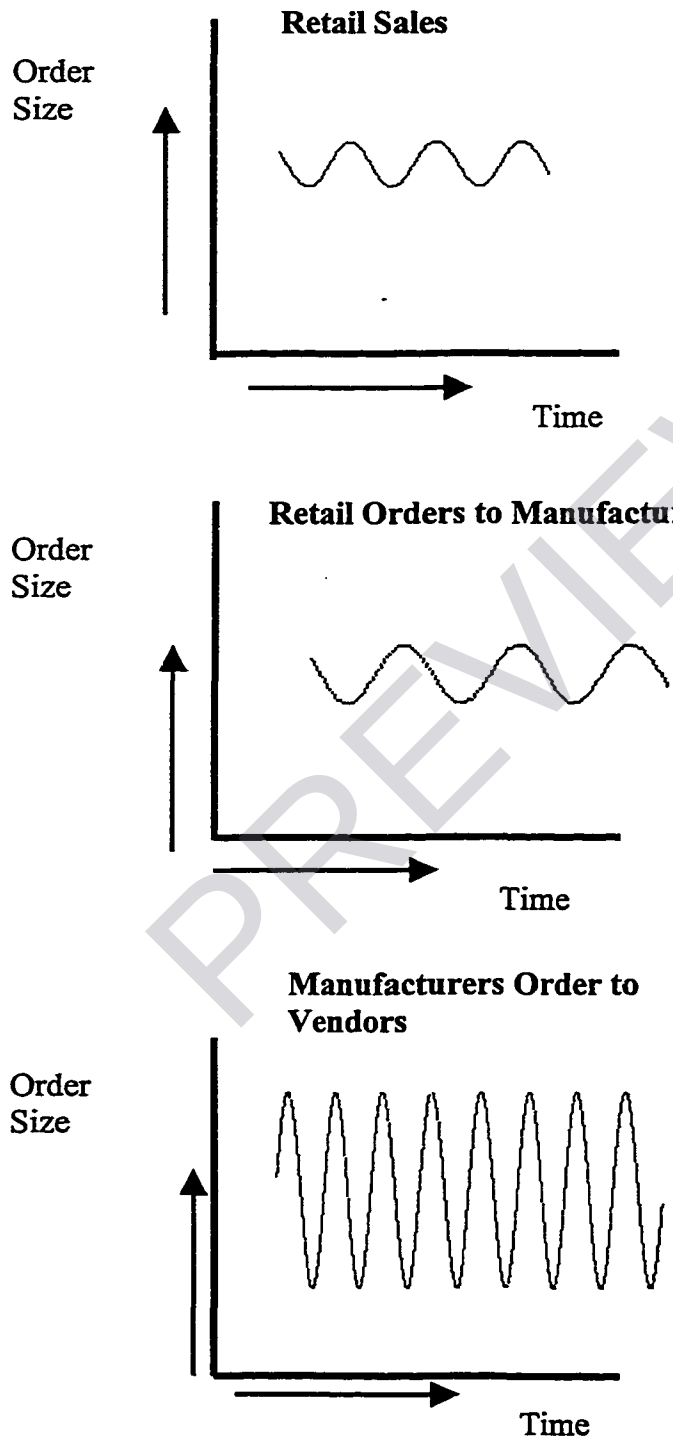
Entering the new millenium, organizations must consider the issues of increased competition, rising customer expectations and the demand for increased product variety. Organizations will simultaneously be forced to decrease profit margins and cope with changing governmental regulations, such as taxes and tariffs to remain competitive (Rockhold et. al. 1997). To handle these pressures, organizations are forced to consider the impact of operational decisions on not only their own company but also all members of their supply chain. No longer will firms compete against each other individually but rather they will compete with their respective supply chains (Schorr 1998).

Most organizations struggle with the issues surrounding their individual organization and have an even greater difficulty dealing with multiple organizations and supply chain partners. Previously effective organizations are those that have been able to control the impact of variability on their internal processes. Unfortunately, when dealing with supply chains, variability gets magnified and intensified upstream in the supply chain (Metters 1999, Lummus and Vokurka 1999, Lee and Tang 1998, Lee et. al. 1997, Forrester 1961, Burbridge 1961). Often referred to as the "Bullwhip Effect" in today's literature, the impact of this variability amplification has large ramifications towards the design of the ideal supply chain (Towill 1998).

The impact of the bullwhip effect can be very damaging to members of the supply chain, especially the second and third tier suppliers. Consider a simple example of consumers deciding to switch to a new computer because of a faster microprocessor. At the consumer end of the supply chain this change of preferences creates a ripple in the supply chain (i.e. orders for the new compute rise). Due to forecast lags, delivery reliability problems, miscalculation of the size of spike in demand and other factors the ripple gets magnified. The effects accumulate, resulting in large swings in orders further back in the supply chain. An example from the machine tool industry can help see the bullwhip effect in action. From 1961 to 1991 the gross domestic product (GDP) had swings in the range of 2 to 3 percent, the automotive industry had swings of +/- 20 percent and the machine tool industry had swings in consumer orders +/- 60 to 80 percent (Fine 1998). The resulting swings forced hundreds of companies out of business. Figure 1 provides a graphical description of the bullwhip effect.

To reduce the effect of the demand amplification, many organizations are looking towards inter-organizational information systems. The major benefit of sharing information is to reduce the bullwhip effect that can distort demand information and increase relevant supply chain costs (Lee and Tang 1998). Information sharing between suppliers and customers can lead to a source of competitive advantage (Porter and Millar 1985). Since the adoption of just in time (JIT) by U.S. firms, electronic data interchange (EDI) has been used to exchange key pieces of data between organizations. This data exchange methodology is commonly used in manufacturing and services to exchange inventory reordering and purchasing data.

FIGURE 1.1 THE BULLWHIP EFFECT



Often the goal of these EDI type systems is to reduce or remove the amount of variability in a system, by reducing the reduce lead-time, paperwork in the system and by providing real-time monitoring of logistics and warehousing processes. Although, EDI has been shown to be successful for many organizations the cost of using EDI systems has limited its widespread adoption (Wang and Seidmann 1995).

More recently, companies are turning to e-commerce and Internet applications as a means of creating information links with customers, suppliers, vendors and distributors (Latamore 1999). The Internet allows companies to simultaneously establish data communication links in multiple departments and with multiple organizations. Nearly half of all large U.S. organizations are currently reconsidering their information network infrastructures to take advantage of Internet technology (Computerworld 1997). In an unpublished survey of purchasing managers taken by NAPM (North American Purchasing Managers Association), over 50% of manufacturing and service organizations polled report using some form of e-commerce in their business processes. A majority of these firms will increase their Internet budgets and many will be spending in excess of $1 million annually on Internet technology (Computerworld 1997). The major advantages of the use of Internet technology over the traditional forms of data transmission are the significant reduction in cost of the application and ability to transmit multiple forms of information including graphical data.

Despite the wide spread use of these technologies such as the Internet and EDI to exchange information between organizations, many firms and supply chains report no significant impact on their performance or costs. Several factors have limited the success

of EDI systems in the past; two primary reasons include the cost prohibitive nature of the product and failure to modify the processes around the new technology. While the Internet helps to solve some of the cost issues surrounding adoption of the technology it still does not force an organization to reengineer their processes to use the technology. Only through re-engineering of the business process channels can an organization realize the full potential for improving company performance (Short and Venkatrman 1992). The automation of activities in the supply channel without actually changing the structure of the process will have very little impact on performance. Many authors now suggest that organizations must change their business processes to realize the savings enabled by these technologies (Mukhopadhyay 1994, Venkatraman 1994). In a recent study, it is noted that simply prescribing to a philosophy or technology will have minimal impact on organizational success, unless one pays attention to the infrastructure practices of the organization (Sakakibara et. al. 1997).

Much of the just-in-time philosophy (JIT) has been towards developing simple systems that help to eliminate waste. Often times the use of information technology is reduced or eliminated in the use of JIT systems. Many authors have stated the goal of JIT purchasing to be (Schniederjans 1993, Schorr 1998):

1. develop long term contracts with suppliers;
2. improve the accuracy of order filling;
3. improve quality of products and processes;
4. ordering flexibility;
5. delivery of small lots frequently; and

6. continuous incremental improvement of processes.

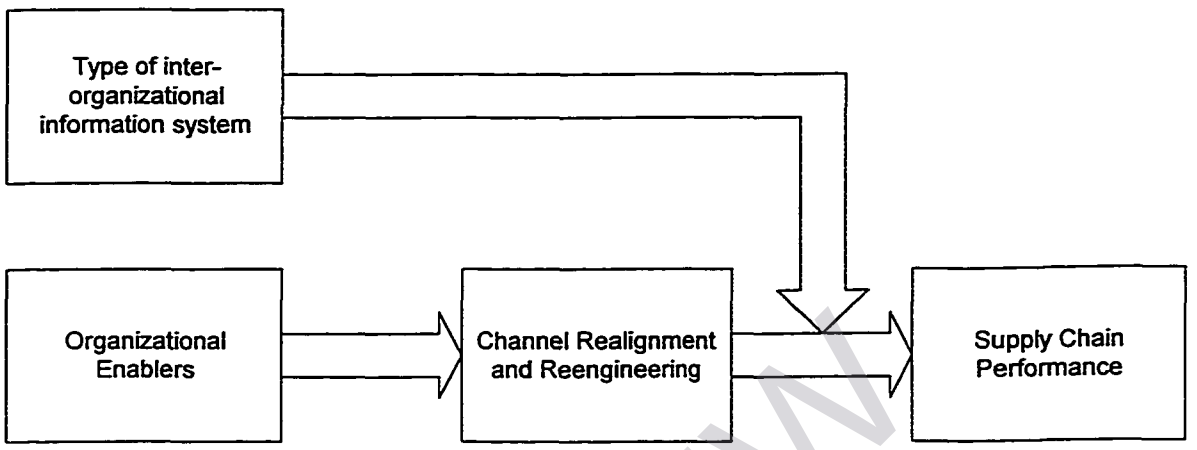
In general, we could consider the use of JIT as a means to realign or restructure information channels between organizations. In lieu of these organizations successfully using JIT purchasing practices, many companies are still turning to the use of technologies such as EDI and the Internet as a potential means to improve their operations.

The question arises, with all of these companies spending countless dollars on computer-based applications for the exchange of data between organization, do they have a significant impact on the performance of the organization or supply chain? The goal of this research is to examine the impact of reengineering/realignment of the purchasing supply channels on the performance of the supply chain. This study will also determine if the type of information technology employed in the process has an impact on level of success a supply chain achieves.

1.2 Purpose of Study

It is the purpose of this study to determine factors associated with successful and unsuccessful implementation of realignment/reengineering projects in the purchasing function of supply chains at varying levels of inter-organizational information systems commitment. Figure 1.2 shows that organizational enablers' influence channel re-engineering efforts moderated by type of information technology used in the process. To date no previous study has examined how the level of information technology (IT) commitment impacts channel reengineering efforts and what are their impact on overall supply chain performance.

FIGURE 1.2 GENERAL RESEARCH MODEL



1.3 Key Definitions

The following definitions explicitly define channel realignment and reengineering, level of IOIS commitment, organizational enablers and firm performance measures that are critical to this study.

1.3.1 Definition of Channel Realignment and Reengineering

The method most commonly used to restructure business processes is Business Process Reengineering (BPR). The APICS (1995) dictionary defines Business Process Reengineering (BPR) as "a procedure that involves the fundamental rethinking and radical redesign of business processes to achieve dramatic organizational improvements in such critical measures of performance as cost, quality, service, and speed." Others offer competing definitions of BPR (Grover et. al. 1993):

1. The analysis and design of work flows and processes within and between organizations.

2. A methodological process that uses information technology to radically overhaul business process and thereby attain major business goals.

3. The reconfiguration of the business using IT as a central lever.

4. Overhauling of business processes and organization structures that limit the competitiveness, effectiveness, and efficiency of the organization.

Several key elements are contained within these definitions of BPR: (1) BPR consists of *radical* or at least significant change; (2) BPR tries to achieve major goals or dramatic performance improvements; (3) information technology is a critical component to successful BPR; and (4) organizational changes are a necessary component of BPR and must be managed accordingly.

For purposes of this study, re-engineering the supply channel refers to the modification of the purchasing channels to take advantage of new methods and technologies. Examples of this reengineering process include vendor managed inventory (VMI) and the continuous replenishment process (CRP) adopted by the grocery industry. These programs are designed to eliminate the need for orders in the supply channel (Clark and Hammond 1997). These programs represent an entirely new method to share purchasing and inventory data across organizations. While EDI represents an electronic method to share information across organizations it did not require a fundamental change to the purchasing channel. The use of CRP/VMI provides vendors with much more timely and detailed information on product movements and stockouts. Essentially manufacturers determine the quantities to ship to retailers based on current demand levels. Demand data are transmitted daily from retailers to manufacturers daily through inter-organizational information systems and the manufacturer determines the appropriate

shipment size to send to the retailer. Several organizations have adopted the VMI process as a means of controlling inventory. These companies include Campbell's Soup Company, Wal-Mart, Lucent Technologies, and many other suppliers and major manufacturers.

1.3.2 Use of Inter-organizational Information Systems

This section outlines the types of information technology used in the purchasing channels in the supply chain. Firms can essentially adopt one of three IT strategies for the purchasing function of the firm:

- Use no IT system to exchange data between organizations and use traditional methods to order information.
- Use traditional EDI systems to exchange data between organizations in the supply chain.
- Use the Internet and E-Commerce to exchange data between organizations in the supply chain.

Many channel-reengineering projects would have difficulty achieving success without simultaneously using an information technology in the process (Short and Venkatrman 1992). In an effort to improve order accuracy, quality and lead-time in supply channels many organizations invested heavily in the use of EDI. The APICS (1995) dictionary defines EDI as the paperless (electronic) exchange of trading documents such as purchase orders, shipment authorizations, and invoices, using standardized document formats. The traditional form of EDI uses a dedicated system to exchange key purchasing data between key members of the supply chain. These systems