The Impact of Information Sharing on Order Fulfillment in Divergent Differentiation Supply Chains

Troy J. Strader
Iowa State University, USA

Fu-Ren Lin
National Sun Yat-sen University, Taiwan, R.O.C.

Michael J. Shaw
University of Illinois at Urbana-Champaign, USA

Current information technology (IT), such as extended intranets (extranets) utilizing the components of the World Wide Web (WWW), makes information sharing between global supply chain partners feasible. Given this, an important issue is: What impact does efficient information sharing have on supply chain order fulfillment performance (specifically cycle time and inventory costs)? In this study, we focus on divergent differentiation supply chains (commonly associated with industries such as fashion apparel). We identify the impact of information sharing by simulating order fulfillment in this supply chain type and find inventory costs can be reduced while maintaining acceptable order fulfillment cycle times. This is true because information, which provides the basis for enhanced coordination and reduced uncertainty, can substitute for inventory.

In today's business environment, organizations are finding that efficiency alone is insufficient for maintaining competitiveness. Malone (1991) states that "the revolution of the 1990s is driven not by changes in production and transportation but by changes in coordination" (p. 128), particularly global interorganizational coordination. One example of an attempt to improve coordination and competitiveness is supply chain management. Supply chain management expands the scope of the "organization" being managed beyond the enterprise level to include interorganizational relationships, and they typically involve global operations. Examples include improving coordination between suppliers and manufacturers, as well as between manufacturers and distributors. As improvements in information technology (IT) have enabled the costs of coordination to decrease (Malone, 1987), there has been a general movement toward organizing as partnerships between more specialized firms or business units.

Supply chain management is an important topic to study because it is an instance of these partnerships.

Most management information systems (MIS) research related to supply chain management has concentrated on identifying the information requirements of local supply chain node decision making (Billington, 1994; Davis, 1993; Lee, 1992; Lee, 1993a; Lee, 1993b; Swaminathan, 1994). Often this involved development of models of material and information flow through the supply chain network (SCN). The purpose of our research is to analyze the impact of information sharing on one supply chain type. We study divergent differentiation supply chains (commonly seen in industries such as fashion apparel). The term divergent differentiation is applied to these supply chains because their structure diverges from a relatively small number of suppliers to a wider range of
assemblers and distributors. They also involve products
differentiated at the assembly stage by combining a relatively
small number of components into a much larger number of
final products. It is important to study these supply chains
because they are seen in a number of industries, including
many types of clothing firms, and involve a large range of
product variations, short product life cycles, and a primary
objective is responsiveness (Fisher, 1994). Additional char-
acteristics of these supply chains are discussed in more detail
later in the paper.

We investigate the characteristics of supply chain man-
agement in an environment of electronic commerce. This
environment includes (1) centralized, global business and
management strategies (e.g. make-to-order, assemble-to-or-
der and make-to-stock), (2) on-line, real-time distributed
information processing to the desktop, providing total supply
chain information visibility, and (3) the ability to manage
information not only within a company but across industries
and enterprises (Kalakota, 1996). Within an overall frame-
work for studying electronic commerce, our research is at the
application level (e.g., supply chain management) enabled by
the information superhighway, multimedia content and net-
work publishing, messaging and information distribution, and
common business services infrastructures (Applegate, 1996).
This five-level framework was developed to succinctly cap-
ture the major elements and features of electronic commerce
to enable it to be better understood. Side issues, which are
outside the scope of this paper, related to this framework
include public policy, legal and privacy issues, as well as
technical standards for electronic documents, multimedia and
network protocols.

We discuss our analysis in the following sections. We
present a brief overview of supply chain management, discuss
technologies that enable feasible, efficient, information shar-
ing between supply chain partners, and analyze, based on a set
of simulations, how information sharing affects overall supply
chain network performance. Finally, we present our conclu-
sions.

Supply Chain Management

We introduce supply chains by presenting (1) a general
overview of supply chain management, and (2) a summary
description of supply chain management.

General Overview of Supply Chain Management

A supply chain is a network of facilities that procures raw
materials, transforms them into intermediate subassemblies
and final products and then delivers the products to customers
through a distribution system (Billington, 1994). Supply
chains exist in virtually every industry, especially industries
that involve product manufacturing. Management of supply
chains is a difficult task because of the large amount of
activities that must be coordinated across organizational and
global boundaries. The most common problems involve
coordinating materials inventory and production capacity
availability across several organizations to produce products
that can satisfy forecasted demand in a highly uncertain
environment.

Several factors are making supply chain management an
important issue for today’s managers. These factors include
(1) more instances of multisite manufacturing, where several
independent entities are involved in the production and deliv-
ery process, (2) increasingly cut-throat marketing channels,
(3) the maturation of the world economy, with heightened
demand for “local” products, and (4) competitive pressures to
provide exceptional customer service, including quick, reli-
able delivery (Davis, 1993). In the past, management would
concentrate on making each node of the supply chain network
efficient. What managers are now realizing is that efficiency
at each node does not result in the supply chain as a whole
operating optimally. Increasingly, the challenges related to
improved product quality, customer service and operating
efficiency cannot be effectively met by isolated change to
specific organizational units, but instead depend critically on
the relationships and interdependencies among different orga-
nizations (or organizational units) (Swaminathan, 1994).

Supply chain management is a management process that
attempts to optimize the operation of the entire supply chain.
Different entities in a supply chain typically operate subject to
different sets of constraints and objectives. Even when
belonging to the same company, supply chain entities often
report to different divisions. Supply chain entities are highly
interdependent when it comes to improving due date perfor-
mance, increasing quality or reducing costs. As a result, the
welfare of any entity in the system directly depends on the
performance of the others and their willingness and ability to
coordinate (Swaminathan, 1994). Specifically, supply chain
management involves balancing reliable customer delivery
with manufacturing and inventory management costs
(Billington, 1994). Two metrics commonly used to measure
overall supply chain performance include order fulfillment
cycle time and inventory level and cost.

One major problem involved in supply chain manage-
ment is understanding and managing the uncertainties in-
volved in the supply chain. This is especially true in the
fashion skiwear industry (where divergent differentiation sup-
ply chains are prevalent) where demand is heavily dependent
on a variety of factors that are difficult to predict - weather,
fashion trends, the economy - and the peak of the retail selling
season is only two months long (Fisher, 1994). Different
sources of uncertainty exist along a supply chain. They
include demand (volume and mix), process (yield, machine
downtimes, transportation reliabilities), and supply (part qual-
ity, delivery reliabilities) (Billington, 1994; Lee, 1993a; Lee,
1993b). Inventories are often used to protect the chain from
these uncertainties.

Another major problem involved in supply chain man-
age is the management of lead-time. This is discussed in
more detail in a later section. The role of information technol-
ogy (IT) in supply chain management is to assist managers in
managing uncertainty and lead time through improved collec-