# ABSTRACT

LAUER, CHRISTOPHER MORIARTY. Improving the Competitiveness of US Textile Manufacturers with E-business Initiatives Related to Supply Chain. (Under the direction of Dr. George Hodge.)

This research conducted case studies to define the benefits, costs, and risks employed with the use of E-business in supply chain management. The case studies further explored the relationship with customers and suppliers in the supply chain based on adopting E-business initiatives. Open-ended, in-person interviews with US textile manufacturing companies were also conducted.

This study used a two-phase mixed methods approach in order to gain secondary data resources and primary data from in-depth interviews with industry executives. Ten textile manufacturing companies in the Southeastern United States were interviewed. All of the interviews were conducted in person except for one that was conducted via telephone. Three in depth case studies were conducted addressing the uses of e-business initiatives based on VAN and the internet.

A list of B-2-B supply chain transactions were complied based on the sample's responses. These transaction are being exchanged by VAN EDI based on 58% of the sample has this e-business technology in place. Advance shipment notification is the transaction that is being exchanged the most between trading partners. The advance shipment notification is then being used to manage raw material and finish goods inventory. This study also found that the lack of IT knowledgeable staff, the cost of e-business technology, and the small demand for this technology from their supply chain partners are the main barriers of e-business implementation. However, the companies in this sample that implemented e-business into their supply chain have seen: an increase in

data accuracy, transaction cost reduction, decrease time spent on non value added tasks, and improved customer satisfaction levels.

This study also contains three case studies that focused on the implementation of e-business into an US textile manufacturer's supply chain when dealing with B-2-B transactions. The first case study focused on what is the cost difference for a greige fabric manufacturer to send or receive an advance shipment notice manually, through a VAN EDI system, or AS2 software. The second case study concentrated on why a large spun yarn manufacturer's customers are starting to inquire about having information made visible on the internet and also what benefits does this create for their supply chain. Third case study documented how a fabric manufacturer customized a process to eliminate VAN charges when exchanging B-2-B supply chain information.

# Improving the Competitiveness of US Textile Manufacturers with E-business Initiatives Related to Supply Chain

By
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# Biography

The author, Christopher M. Lauer, was born in Cedar Rapids, Iowa on May 20, 1980. He is the son of Chuck and Maribeth Lauer. In 1998 Chris went to study at North Carolina State University. He achieved a Bachelor of Science in Textile and Technology Management with a concentration in Business Management from the College of Textiles in 2002. Upon graduation Chris worked for Milliken and Company where he gained experience as a Product and Process Specialist in the weaving and slashing technology. In the fall of 2004, Chris returned to North Carolina State University to pursue a Master of Science degree in the Institute of Textile Technology program as a Milliken Industrial Fellow. He is currently completing the requirements for his graduate degree in Textile Management and Technology. Chris is returning to Milliken and Company to pursue a career in supply chain and business management.

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Finally, I would like to thank my mom and dad for their support, love, and encouragement through every challenge I have faced. And, lastly I would like to express my gratitude to my beautiful wife to be, Laura Scott, for her constant love, motivation, and belief in me.

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# 1 Introduction

The US textile manufacturing industry is facing a higher level of competition everyday due to globalization, and for this industry to generate profits in the future, it must create strategies based on new initiatives. E-business could possibly be one of these initiatives because of its ability to increase the velocity of information exchange and manage business transactions across great distances between corporations in a supply chain. According to the 2004 European E-business report, "Successful textile manufacturing companies are paying attention to strategic issues such as: optimization of production processes with the aim of reducing time to market and lead time and IT systems able to integrate the whole supply chain: from point of sale to order management and logistics (European Commission, 2004 P. 25)." The European textile industry is facing the same global challenges as the US market, and they are becoming more competitive by improving their supply chain performance through e-business initiatives.

The US textile manufacturing industry's value has declined by fifteen percent from 1999 to 2003, which is show in Figure 1. Value of Shipments are defined as the market value of all commodities shipped from a plant, which includes shipments to outside customers as well as to affiliated plants (US DOC, 2004). This decrease in value is a combination of economic, technology, and market forces. These forces will cause this market examine and reinvent their supply chain strategies to reduce cost in order to offset this decline in value. According to Lee, "To stay competitive, enlighten companies have strived to achieve greater coordination and collaboration among supply chain partners in an approach called supply chain integration. (Lee, 2001 P.5)." This integration can eliminate supply chain deficiencies,

and which can cost companies between nine and twenty percent of their value over a six month period of time (Becker, 2000).

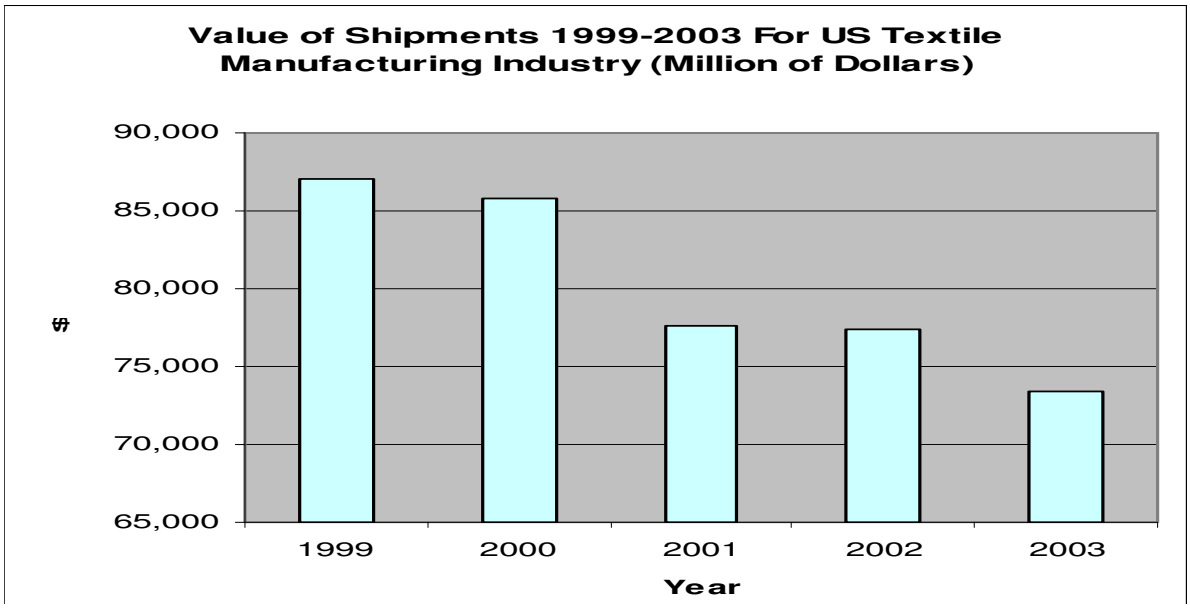


**Figure 1 US Textile Industry $ Value of Shipments**

Source: US Census Bureau. (1999-2003). E-commerce multi sector report. Retrieved August 29, 2005, from E-stat website http://www.census.gov/eos/www/archives.html

It is very important for US textile manufacturers to understand how the integration of their supply chain can reduce their product's cost. Integration can be achieved by using e-business tools in this industry's supply chain, which will improve their cost and performance. In Table 1, the results of a benchmark study conducted by PRTM illustrates the potential benefits of an integrated supply chain. According to this study, the supply chain costs will improve by 25%-50% due to integration.

**Table 1: Supply Chain Integration Improvements**

| Area | Improvement |
|---|---|
| Delivery Performance | 16%-28% |
| Inventory Reduction | 25%-60% |
| Fulfillment Cycle Time | 30%-50% |
| Forecast Accuracy | 25%-80% |
| Overall Productivity | 10%-16% |
| **Lower Supply-Chain Costs** | **25-50%** |
| Fill Rates | 20%-30% |
| Improved Capacity Realization | 10%-20% |

Source: PRTM. (1997), *Sixth annual supply chain performance benchmarking study*. PRTM.

Despite the importance of the textile and apparel industries to the United States' economy, little research has been conducted on how and why e-business technology is being used in the US textile manufacturing supply chain. The lack of cooperation from the members of this industry has made it difficult to understand how or if supply chains are being integrated in textile manufacturing. Therefore, an opportunity existed to perform an analysis of the market competitiveness in the US textile supply chains and to examine how e-business technology is being implemented into these functions.

## 1.1 Purpose

The purposes of this study were to:

1. Define what are the business-to-business transactions being used in the US textile manufacturing supply chain.
2. Determine how US textile manufacturers are using e-business initiatives in supply chain management when dealing with business-to-business transactions.
3. Determine what benefits and barriers US textile manufacturers are facing when implementing e-business initiatives into their supply chain.

The primary objectives were to collect data from a sample of manufacturers that deal with textile processes and which are located in the southeastern part of the US to:

RO1 Develop a definition for supply chain business-to-business transactions in US textile manufacturing.

RO2. Identify if e-business technologies are being used in the current US textile manufacturing supply chain practices that deal with business-to-business transactions.

RO3. Understand what type of data companies are exchanging with each other within the US textile manufacturing supply chain when using business-to-business technology.

RO4. Determine how this data is being used by US textile manufacturers after receiving it.

RO5. Determine how often these companies are exchanging this information.

RO6. Determine the barriers that are hindering the use of business-to-business technology in the US textile manufacturing supply chain.

RO7. Determine the benefits that influence US textile manufacturers to implement business-to-business technology into their supply chain strategy.

RO8. Develop strategies that US textile manufacturers can follow to implement e-business in respect to supply chain management.

## 1.2 Significance of This Research

This study describes the e-business environment for the US textile manufacturing industry with respect to supply chain and business-to-business transactions. The description of this environment reveals how US manufacturers are using business-to-business technology, how often they are sharing data with this technology, and what data they are

sharing. From this information, in-depth case studies will be conducted with selected companies.

The second phase of this research will develop case studies that will provide significant information on how US textile manufacturing companies are implementing this e-business strategy into their supply chain. The implementation plan will allow US companies to understand what benefits, costs, and risks are employeed with e-business and supply chain management.

## 1.3 Limitations of This Research

1. The study only focuses on one segment of the textile industry: manufacturing. Even though this is a major part of this industry, the study's results cannot be applied to other segments of this industry.
2. The sample size only consists of a representative sample from the one segment due to inability to include the entire population; this is a convenience sample.
3. Depending on the position of the respondent, there may be potential inability error in that they may not have access to the complete data needed to answer certain questions.
4. There is potential for respondent bias depending of the willingness of respondents to disclose actual and accurate numerical data.

# 2 Literature Review

Recent literature on e-business and supply chain management has been reviewed. The primary focus of this review was to get a basic understanding of what e-business technology entails. Also, this chapter describes how supply chain management is being combined with e-business technology to improve the competitiveness of US manufacturers.

## 2.1 What is E-Business

The term e-business is sometimes considered to have same the meaning as e-commerce, but they are not the same. E-business means doing business online, finding and interacting with customers, communicating with business partners and suppliers, and developing new products and markets (Worthington, 2002). E-commerce is defined as selling goods and services online (Mesenbourg, 2001). When comparing the two definitions, e-commerce is part of conducting e-business, because e-business incorporates all business activities conducted electronically and e-commerce just includes the selling process over the internet.

Since e-business includes such a broad number of business processes it has been broken down into two categories, business-to-business and business-to-customer. So what are the definitions of these terms? Business-to-business (B-to-B) is that both seller and buyer are business corporations, and Business-to-Customer (B-to-C) reflects that buyers are individual consumers (Dou, 2002). The B-to-B category is a much larger market than B-to-C, and according to Forrester Research in the US B-to-B transactions will total $2.7 trillion in 2004 (Dou, 2002).

## 2.2 Barriers

A company will face many barriers when implementing an e-business strategy into operation from internal and external factors. According to Begin and Boisvert, there are barriers that are individual and organizational for internal barriers. The individual level influences are employee's perceptions of e-business eliminating their jobs and a transition to the electronic era is not uniformly easy for all employees (Begin, 2000A). Employees are not the only stakeholders who can be reluctant to e-business. Reluctance could also come from the company executives. Executives could be reluctant to implement e-business practices because of a poor understanding of the possible uses and its benefits (Begin, 2000A).

The organizational barriers are the organizational culture, technology, and expertise. Traditional bureaucratic cultures that do not encourage innovations could be consider a barrier in B-to-B implementation (Begin, 2000A). To be a part of the e-business marketplace a company must have a highly developed computer infrastructure in place. If this is not in place, it will take a large investment to be up to par, and this cost might deter a company from being involved in e-business. Another barrier a company might encounter is the expertise to design web-sites and market structures that are needed for customers to buy products (Begin, 2000A).

There are also external factors that the company has little control over, but it must take into account when implementing an e-business strategy. One barrier is the purchasing customs a company operates in, and if there is too little of demand for a distribution channel on the internet, then a company should not create one (Begin, 2000B). The type of product is another barrier. For example, made-to-measure industrial products, products employed with

sensory experiences, and products with extremely high prices are not the type of products a company starts their e-business campaign with. If the transaction is complex based on the sales price being too high then the subject of negotiation is another barrier to conduct business over the internet (Begin, 2000B). To conduct e-business both the supplier and customer must have the infrastructure to handle certain demand, but if the company's customers do not have this in place there is no need for implementing an e-business initiative.

## 2.3 Benefits

E-business can create many benefits for a company, and according to Mahadevan (2003), there are three distinctive factors: increased reach, reduced transaction costs, and deep customization capabilities. The supply chain in the textile industry is becoming more fragmented due to globalization, but in an e-business market it is more of a level playing field. It becomes a level playing field because buyers are able to globally locate new and cost effective sources of supplies and reduce input costs (Mahadevan, 2003). Suppliers also benefit from this because they are able to attract global customers who might have been unreachable before (Mahadevan, 2003).

Every company conducting business incurs transaction costs, and according to The National Association of Purchasing Managers, the average manual purchase order costs a company $79 to process and $38 is from internal processing. This is one area that a company can reduce costs by using the internet infrastructure. Organizations can integrate their supply chain and use software to efficiently managed approval for purchases and other complex business processes (Mahadevan, 2003). Also, coordinated production planning and control

among the supply chain enables better demand management. This could lead to eliminating unwanted inventory from shipping across the supply chain (Mahadevan, 2003).

Another factor that has become important to the US textile industry is flexibility, and the deep customization capabilities of e-business can address this factor in different ways. First, e-business can pre-configure the structure for the market participants to become more organized. For example it can help develop preferred suppliers lists and pre-specified procured items (Mahadevan, 2003). As information about the entire value chain related to the transaction is available to the buying organizations, it can rationalize its investments in inventories, make accurate production plans, and commit firmly to its downstream customers (Mahadevan, 2003).

The type of benefits a company generates through the use of e-business can be determined if they are in a digital market. According to Sawhncy, digital markets are made up of hubs. A hub is a contextual digital market and can focus on a specific dimension of it, and they can be vertically along a specific industry or horizontally along a specific business function (Sawhncy, 1999). According to Dou, if a company is in a vertical digital market they can use the liquidity and transparency to reduce purchase prices and cycle time. Also, a successful digital market possesses the capability for electronic payments, which can reduce operational and processing cost and also speeds up the transactions.

## 2.4 E-Business and Manufacturing

Many consider the emergence of internet e-commerce an outgrowth of electronic data interchange (EDI), but it is rather an evolution from EDI (Soliman, 2003). According to Worthington, EDI allows many manufacturers to tighten up their just-in-time manufacturing and lower supply chain costs, but it still has some drawbacks. These systems are not real-

time or interactive, are expensive, have high transaction costs, and are not widely adopted (Worthington, 2002).

However, EDI is a tool to conduct e-business that is performed over a value added network which is different than new technologies being used to conduct e-business. First the new tools are based on the internet and web technologies, which makes the communication medium public (Worthington, 2002). Since these new tools can be accessed through web technologies, it is interactive, inexpensive, and widely accepted compared to EDI (Worthington, 2002).

A manufacturing company that implements an e-business strategy will allow themselves to reduce costs and to develop a stronger relationship with their customers. Manufacturing companies will be able to cut handling and inventory costs by automating and aggregating purchasing and integrating the manufacturing process into the supply chain (Worthington, 2002). Manufacturing companies can develop a stronger relationship with their customers through e-business by streamlining information delivery and by bringing distributors into e-commerce initiatives (Worthington, 2002). This enhances the customer service level because it provides customers self-access to their accounts, transactions, and orders (Soliman, 2003).

An example of a company in the textile manufacturing business that is using e-business is Fruit of the Loom. According to Worthington, Fruit of the Loom uses the web to tie together its network of distributors so they can provide customers with information on their mills and distributors' inventories. They are able to do this because they implemented an online catalog that has a complete product database and ordering information; online customer billing, which routes through accounts payable to handle postal mail billing and

payment; and bulletin boards and chat rooms so customers can exchange information with each other (Worthington, 2002).

There are some challenges when using e-business. According to Soliman, the two issues receiving the highest attention are security issues and payment tools. The security issue has become a lesser factor in e-business because it would not be possible if there were no means of ensuring security. There has been a growing confidence in internet security, since companies have been using secure web servers that have cryptography or encrypted text and special protocols (Worthington, 2002). Special protocols provide a secure link from the user's computer to a known server that has been identified by a certificate of security, and an example of this is Secure Sockets Layer (SSL) and Transport Layer Security (TSL) (Worthington, 2002). All of these tools allow secure web sites to encrypt order data from your browser before it is uploaded.

There are many traditional payment methods for companies, but for e-business there was a lack of payment methods until newer methods were created. These new methods include digital cash, which is a token based currency and is translated into the equivalent of real currency units guaranteed by a bank (Soliman, 2003). Other methods include electronic cheques and encrypted credit cards. The new security and payment tools have lowered the risk for manufacturing companies to conduct business over the internet.

So where is the future of manufacturing heading? According to Worthington, it is heading towards e-manufacturing. E-manufacturing applications are possible from the broad applicability of internet tools and technologies, and therefore new web-enabled solutions are widely available (Worthington, 2002). In the front end of the manufacturing process, up to eighty percent of a plant's conversion cost is locked in when the product design decisions are

being made, and now there are many innovations addressing these costs (Worthington, 2002). For example, real-time collaboration via web conferencing, electronic subcontract and bid management, virtual white boards, and even collaborative manufacturing build packages (Worthington , 2002).

On the production floor, web-based hubs are used for real-time, remote viewing of production data, and on the equipment side, industrial automation software vendors are adding web-based tools for plant decision support (Worthington, 2002). These web-based tools will allow the software to have decision-support aids that look at overall production and quality data in terms of order history, process conditions, alarm analysis, and even work-in-process tracking (Worthington, 2002). Then enterprise resource planning (ERP) and enterprise asset management (EAM) tools are used to integrate plant-level information with internal customer relations management and supply chain management systems for a more efficient manufacturing process (Worthington, 2002).

## 2.5 EDI and Other E-business Tools

Electronic data interchange is a protocol that facilitates the transfer of business information in consistent electronic standard format (Kalakota, 1996). So how does EDI work? According to EDI Source (2003) consultant's white paper, it involves five basic steps, which are shown in Table 2. The agreement to use EDI among trading partners can result in cost reductions, leads to time savings, and allows a less capital binding just-in-time-manufacturing (Emmelhainz, 1993). There are other benefits of using EDI system instead of a paper based system such as : reduce postage costs, information is moved faster and more accurate, and the elimination of labor intensive tasks (EDI Source, 2003).

**Table 2: EDI 5 Basic Steps**

| Step | Action |
|---|---|
| 1 | Extracting data from a computer system, |
| 2 | Translating that data into a format that can be transmitted, |
| 3 | Transmitting the message from one party to the other, |
| 4 | Translatting the message on the receiving end, |
| 5 | Downloading the message (or data) in the receiving computer application |

Source:EDI Sources Inc. (2003). Guide to edi. Retrieved October 20, 2005, from North Carolina State University Business 540 Course web site http://courses.ncsu.edu /bus540/lec/002/1EDI-EDI101(4).pdf

Figure 2 illustrates the process that involves the five basic steps from Table 2. In order for this communication to work between trading partners the data must be supported by a valued added network (VAN), web browser, or the internet. A VAN is third party EDI service provider that provides a communication link between companies so that they may exchange transmissions (EDI Source). These VAN providers charge for the amount of transactions that are exchanged over their communication pathways, and the cost per month for this usage falls in the range of US$ 5000-6000 per month (Bartholomew, 1997). This has become an excessive barrier for small and medium enterprises (SME). Thus, EDI is predominantly implemented by large firms, preventing the electronic processing of data flowing through the entire supply chains in open networks (Weitzel, 2000). This is why companies are now using web browsers and internet technology to transport their EDI transactions.

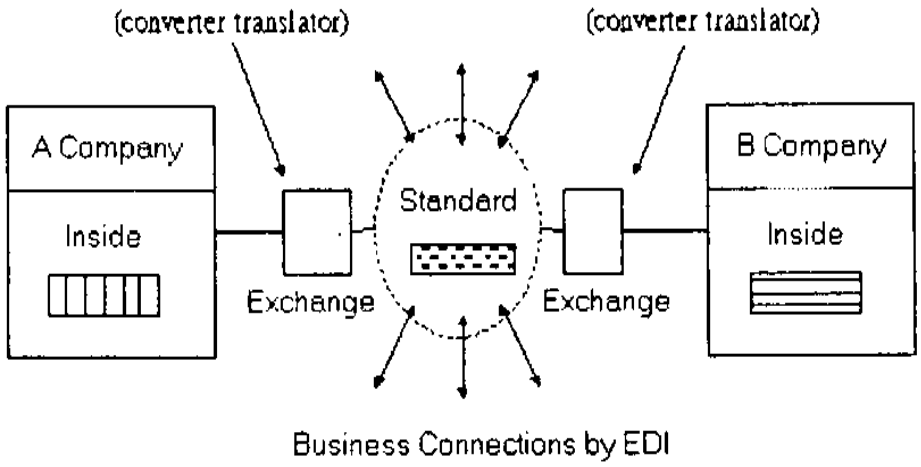


**Figure 2: Illustration of Business Connections by EDI**
Source: Huang, S. M. et. Al. (1999). A digital ordering system in mime protocol. Workshop of commerce automation, Taiwan.

When companies use web browsers to communicate EDI transactions with their trading partners it can be accomplished in two ways. The first process is forms-based orders that are converted on line to standard EDI formats, and the second is extensible markup language (XML) supported applications that enable EDI formats to be displayed in Web browsers (Gardner, 2001). The XML message consists of two main parts: the message content and the message definition (Huang, 1999). The message content contains the information carried in the message (Huang, 1999). According to Huang, the message definition specifies the structure of the message content and provides meaning to different parts of the message. This message definition can also be referred as Data Type Definition (DTD) (Haung, 1999). Then there is internet EDI which is simply transferring files over the internet (Gardner, 2001). Both of these techniques can combine as XML EDI technology, based on that both use XML technology. There are additional benefits companies generate when using XML based EDI compared to VAN EDI, which are summarized in Table 3.

**Table 3: Comparison of EDI Processes**

| EDI Connection | Speed | Cost | Document Size | Flexibility | Security |
|---|---|---|---|---|---|
| VAN | Slower | Higher | Smaller files | Least Flexible Standards | More Secured-Private Network |
| XML | Faster | Lower | 7 times larger | More Flexible Standards | Least Secured-Public Network |

Sources: Gardner, C. Pond, D. & Browning, B. (2001). EDI vrs. xml . *Frontline solutions* , 2(10), 32-36. Peters, L. (2000). Is edi dead? The future of the internet in supply chain management. *Hospital Material Management Quarterly*, 22(1), 42-47.

The speed of transmitting data files between trading partners is increased by the use of XML EDI because this technology allows the information contained by the EDI document to directly proceed to the desired location (Gardner, 2001). The cost of using XML EDI is lower because the use of a VAN is eliminated (Huang, 2000). Again the cost of using a VAN services typically fall in the range of $5000-$6000 per month and also includes hardware costs at both ends in order to have seamless processing (Soliman, 2004). This turns into an excessive obstacle for small medium enterprises due to these additional costs of doing business through the use of a VAN. One challenge that XML based EDI faces is the document size. This document could be as much as seven times larger than their equivalent ANSI X12 document (Gardner, 2001).

The XML EDI also enables trading partners to have easy alteration of transaction content and as well as fast and easy integration into in-house systems due to its flexibility (Weitzel, 2000). This flexibility difference is created because the two different EDI versions have different standards. The VAN EDI uses ANSI X 12 standards developed by American National Standard Institute, and in Table 4 there are six examples of these standards (Gulati, 1995). There are over 300 transaction set titles that ANSI offers, and they are also the ones that develop and maintain these standards (DISA, 2004). These standards and protocols have

to be pre-agreed and are required to due business through a VAN (Soliman, 2004). Due to the higher costs and inflexible standards of VAN EDI, both trading partners are typically contractually tied to a long-term relationship (Soliman, 2004). In such cases, switching costs employeed with establishing a new linkage may prevent companies from changing suppliers that have higher quality or cheaper products (Soliman, 2004). Two of the main standards being used for XML based transactions are ebXML or Rosettanet (European E-business Watch, 2005). These flexible standards allow an optimized integration of components within a system, not only for marketplace purchases and supply but also for content management and document management, such as manufacturing workflows (European E-business Watch, 2005).

**Table 4: ANSI X12 Standards**

| Business Transaction | ANSI X12 Standard |
|---|---|
| Motor Carrier Shipment Information | 204 |
| Motor Carrier Freight Invoice | 210 |
| Invoice | 810 |
| Payment Order | 820 |
| Purchase Order | 850 |
| Advance Ship Notice | 856 |

Source: EDI Sources Inc. (2003). Guide to edi. Retrieved October 20, 2005, from North Carolina State University Business 540 Course web site http://courses.ncsu.edu /bus540/lec/002/1EDI-EDI101(4).pdf

The major disadvantage for using XML EDI is that it is a public network compared to a VAN connection that is a private network. Thus by placing strategic data such as financial reports or manufacturing supply chain data, companies open themselves to potential security breaches (Soliman, 2004). Therefore the private VAN connection decreases the security concerns when exchanging information with trading partners.

EDI is a great way to communicate between two companies. However, an intranet is used to share information within a company. An intranet is a single integrated system that

enables staff to share documents, view and post the latest information, and work effectively across departments (Scottish Enterprise, 2004b). This technology also allows a company to access their suppliers and customer's information over the internet if stored in the company's database (Scottish, Enterprise, 2004b). The web access then lets company employees remotely view this information which permits them to conduct business transactions or update company business records from any part of the globe. Intranet use allows companies to become more efficient in gathering manufacturing information. This will then reduce the cost of non value added tasks and also increase productivity (Scottish Enterprise, 2004b).

Extranet is another private network like intranets, but it is provided to a specific community of users such as customer and supplier (Scottish Enterprise, 2004a). An example of extranet use is when a company secures an area of their public website or an extension of their intranet which allows customers and suppliers to see their own supply chain information (Scottish Enterprise, 2004a). Benefits generated from using an extranet are that suppliers can be updated on the latest stock levels, purchase prices, and production schedules (Scottish Enterprise, 2004a). This allows the manufacturing processes to reduce machines waiting on raw material from the supplier which will increase their production efficiency.

Another e-business tool that will help manage a company's supply chain and manufacturing processes is enterprise resource planning software (ERP). ERP software according to Deloitte consulting, is a "packaged business software system that allows a company to automate and integrate the majority of its business processes; share common data and practices across the enterprise; and produce and access information in a real-time environment." This software evolution started in the 1960's with reorder point systems which evolved into material requirement planning systems in the 1970's (Sumner, 2005).

These systems then advanced into manufacturing resource planning systems (MRP-II) in the 1980's, and then the MRP-II systems in 1990's came with manufacturing execution systems (Sumner, 2005). Finally in the late 1990's, ERP systems were created (Sumner, 2005). This historical evolution is documented with greater detail in Table 5.

**Table 5: Historical Evolution of ERP Systems**

| Types of Systems | Time | Purpose | Systems |
|---|---|---|---|
| Reorder point systems | 1960's | Used historical data to forecast future inventory demand; when an item falls below a predetermined level, additional inventory is ordered | Designed to manage high volume production of a few products with constant demand; focus on cost |
| Materials requirement planning system (MRP) | 1970's | Offered a demand-based approach for planning manufacture of products and ordering inventory | Focus on marketing emphasis on greater production integration and planning |
| Manufacturing resource planning systems (MRP-II) | 1980's | Added capacity planning; could schedule and monitor the execution of production plans | Focus on quality; manufacturing strategy focused on process control, reduced overhead costs, and detailed cost reporting |
| MRP-II with manufacturing execution systems (MES) | 1990's | Provide ability to adapt production schedules to meet customer needs; provide additional feedback with respect to shop floor activities | Focus on the ability to create and adapt new products and services on a timely basis to meet customers' specific needs |
| Enterprise Resource Planning (ERP) | Late 1990's | Integrate manufacturing with supply chain processes across the firm; designed to integrate the firm's business process to create a seamless information flow from suppliers, through manufacturing, to distribution, to the customer | Integrate supplier manufacturing, and customer data throughout the supply chain |

Source: Sumner, Mary (2005). *Enterprise Resource Planning*. New Jersey: Pearson Prentice Hall.

The director of e-business applications at 3com commented, "ERP is a building block of e-business" (Ricadela, 1999). This is because an ERP system can provide a central clearing house for real time information (O'Leary, 2000). This information then provides details for inventory and pricing so companies know what they can sell (O'Leary, 2000). The ERP system also has information that relates to product configuration which can be used for materials requirement planning (O'Leary, 2000). This basic information will then provide a company with the building blocks for e-business functions (O'Leary, 2000).

The way ERP systems communicate to other companies is through the use of EDI or web forms technology (WFT) (O' Leary, 2000). When using a WFT a company provides information on a form that is available on the internet, intranet, extranet, and which may or may not be directly interfaced with a database or other application (O'Leary, 2000). This establishes relationships between customers and suppliers. These relationships then create a virtual value chain that provides information-based channels for manufacturing and supply chain activities (Sumner, 2005). Coca-Cola value chain is illustrated in Table 6. From this example it shows how Coca-Cola is using e-business linkages including ERP systems to generate business benefits in their production processes (Sumner, 2005).

**Table 6: The e-business Value Chain at Coca-Cola**

| Inbound Logistics | Production | Management | Marketing and Sales | Customer Supports |
|---|---|---|---|---|
| Extranets | ERP Software | Intranets | e-business | Internet |
| Links between Coke and its suppliers | ERP Software Links Coke with its bottling partners | Improves worldwide communication | Use cellular linked vending machines | Provide more timely delivery to trade customers |

Source: Sumner, Mary (2005). *Enterprise Resource Planning*. New Jersey: Pearson Prentice Hall.

Companies that have implemented ERP systems to conduct e-business initiatives and to automate their business processes have obtained many tangible and intangible benefits.

Table 7 by Sumner  shows the benefits that were documented in business case studies for companies that have used ERP software.  The tangible benefits of ERP are lower inventory levels, improved on-time delivery, and increased manufacturing throughput (Sumner, 2005). ERP systems also provide soft dollar benefits such as increased sales and revenues, improved margins, and improved productivity (Laughlin, 1999).  These systems can also speed up business processes, reduce cycle time, and reduce the cost of business processes, such as credit checking (Piturro, 1999; Davenport, 2000).

**Table 7: Business Benefits of ERP**

| ERP Performance Outcome | Examples |
|---|---|
| Quickened information response time | • Responses to customer billing inquires occurred in real-time as opposed to 15-20 minute response time at IBM Storage Products Company (Jensen and Johnson, 1999) |
| Increased interaction across the enterprise | • Simplification of processes at Boeing (Jensen and Johnson, 1999)<br>• Growth in interfacility coordination at Owens Corning (Palaniswamy and Frank, 2000)<br>• Real-time access to data across organization at Diebold (Palaniswamy and Frank, 2000) |
| Improved order management / order cycle | • 90% reduction in cycle time for quotations from 20 to 2 days at Fijitsu (Jensen and Johnson, 1999)<br>• Faster, more accurate order processing at Valentine (Palaniswamy and Frank, 2000)<br>• Time for checking credit upon receiving an order was reduced from 15-20 minutes to instantaneous at IBM Storage Products Company (Jensen and Johnson, 1999) |
| Decreased financial close | • 50% reduction in financial closing time from 10 days to 5 days at Fijitsu (Jensen and Johnson, 1999) |
| Improved interaction with customers | • Lead times to customers were reduced from 6 weeks to 2 weeks at Par Industries (Bingi, Sharma, and Godla, 1999) |
| Improved on-time delivery | • On-time product delivery rate increased to 90% at Earthgrains (Bingi, Sharma, and Godla, 1999)<br>• Delivery Performance improved from 80% on-time to more than 90% on-time Par Industries (Bingi, Sharma, and Godla, 1999) |
| Reduced direct operating costs | • Operating margins improved from 2.4% to 3.9% at Earthgrains (Bingi, Sharma, and Godla, 1999) |
| Lowered inventory Levels | • Inventory Levels were reduced significantly at Owen Corning (Palaniswamy and Frank, 2000)<br>• Lower levels of inventory at Valentine (Palaniswamy and Frank, 2000)<br>• Work-in-process inventory dropped almost 60% at Par Industries (Bingi, Sharma, and Godla, 1999) |

Source: Sumner, Mary (2005). *Enterprise Resource Planning*. New Jersey: Pearson Prentice Hall.

## 2.6 Real-Time Integration

The term real-time has been mentioned throughout this study so what does it imply? This research defines real-time information supported supply chain to be a webbed based and not sequential model. For example as Boyson states, "This is a completely new paradigm of supply chain, a webbed model (rather than a sequential model based on handoffs) to attain quantum leaps in time savings and administrative costs." In a webbed textile supply chain model, an order from a retailer then would be seen at the same time as the apparel manufacturer down to the spinner that provides the yarn to make the final product. For companies, this webbed supply chain would allow real-time visibility of information for themselves, their customer, and a supplier and has become a focal point to stay competitive in their industries (Krizner, 2001). Also, when supply chains become highly integrated simple manual batch data collection or information retrieval from nonintegrated automated systems cannot meet the demands of processes and applications in these tightly integrated enterprises (Miklovic, 1999).

The driving force for real-time supply chain management is to divide separating sectors and companies within an industry based on if they are implementing this new technology (Boyson, 2002). This business model is being shaped by three technological trends: accelerating connectivity and broadband networks, the transition to smart networks, and real-time asset visibility (Boyson, 2002). Also, according to a study conducted by Information Week that surveyed 261 business-technology professionals stated that, "half the companies implemented real-time business strategies for improvements in supply-chain efficiencies to cut the time it takes for information to reach key personnel in decision making

positions." Figure 3 illustrates that close to half of the respondents implemented a real-time strategy to make supply chain data more efficiently available to key decision makers.

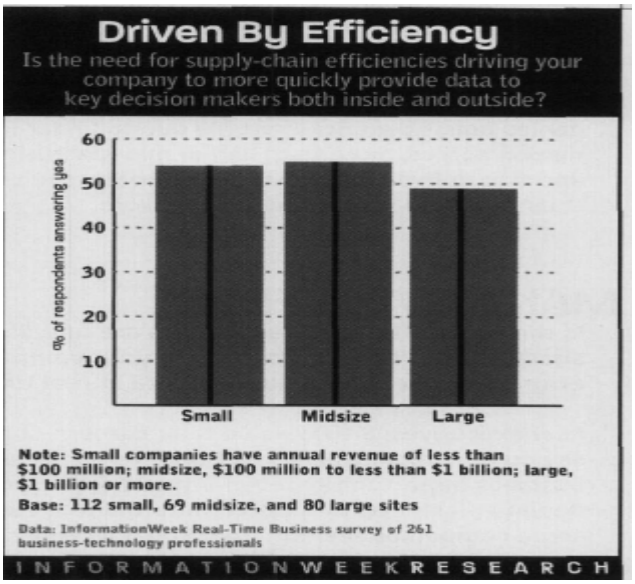


**Figure 3: Real-Time Implementation Due to Supply Chain Efficiency**
Source: D'Antoni, H. (2003). Behind the numbers: real-time aids supply chains. *Information Week*, 936,71-72.

Accelerating connectivity is being driven by the massive investments in fiber and satellite infrastructure capacities which are leading to the doubling of speed of communication every three to six months (Boyson, 2002). Also, the sheer volume of bandwidth is increasing exponentially. For example, the transatlantic fiber capacity expanded ten times between 1998 and 2000 (Boyson, 2002). The transition of smart networks is created by the transformation of software applications. Software applications are moving from separate packaged software bought for internal corporate networks to integrated suites of applications, managed remotely by 3rd party application service providers (Boyson, 2002). This software transition to smart networks is shown in Figure 4. Companies want to have real-time total asset visibility so they can effectively monitor assets such as: inventory in-transit and work in process (Boyson, 2002).

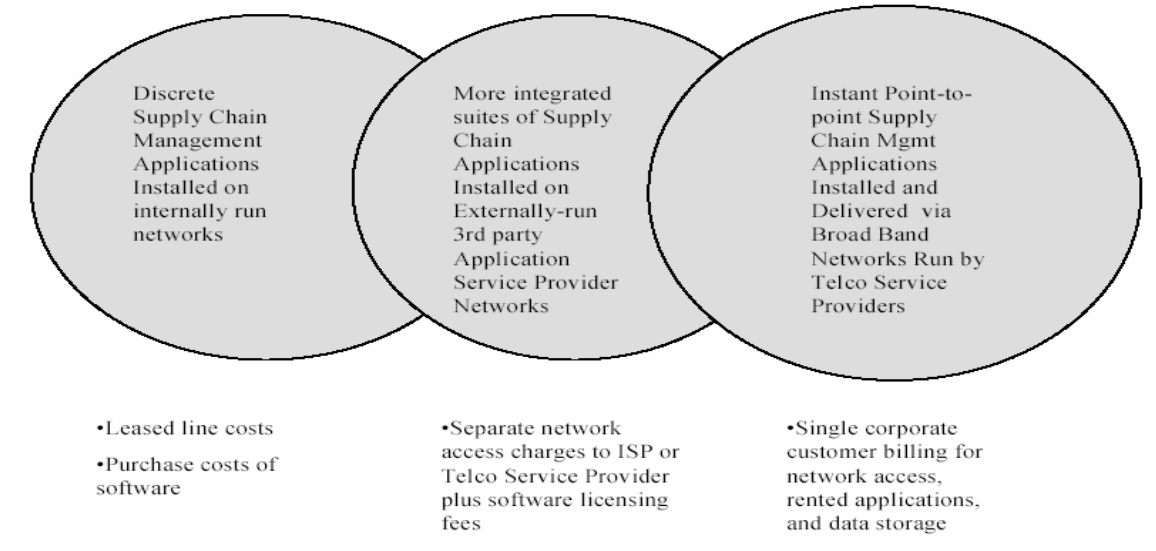


**Figure 4: Transitions to Smart Networks**

Source: Boyson, S. & Corsi, T. (2002). Managing the real-time supply chain. Proceedings of the 35th Hawaii international conference on system sciences.

Real-time supply chains are created when companies unlock their legacy systems which are silos of information for separate business processes, and integrate them together with other companies systems. For example, f a manufacturer does not have a product in stock, a real-time integrated supply chain gives it full visibility into its suppliers' back end system to see whether they have the inventory (Krizner, 2001). An example of an end-to-end real time supply chain is Figure 5. According to Boyson, his figure portrays, " how companies are putting together self-service customer-order portals; ERP systems across internal processes; middleware links to disparate trading partner systems; collaborative planning/forecasting systems to aggregate supply chain community inventory/materials positions and requirements; and purchasing/auction portals to meet those collective requirements." According to Adrian Gonzalez, senior analyst at ARC advisory group, "the better the integration, the more efficient a company is, the better (return on investment), and

the better cost and inventory reduction. The integration will give you bigger benefits on whatever metric you want to measure."

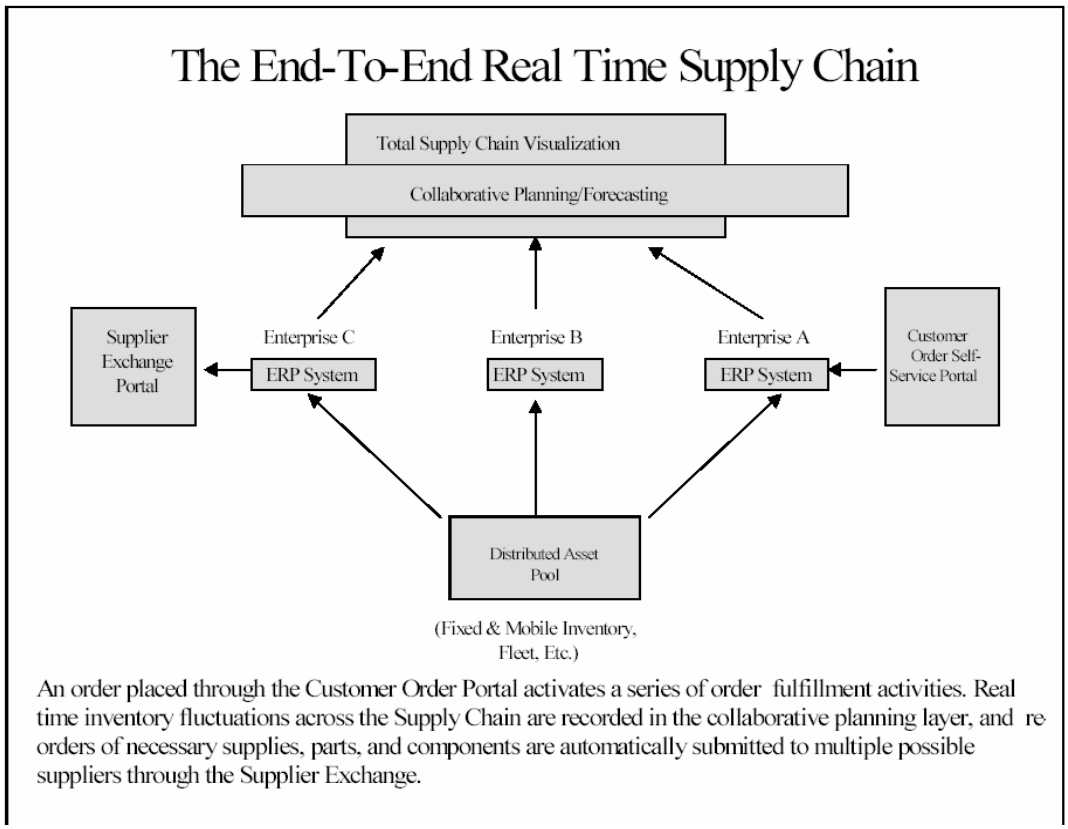


**Figure 5: End-to-End Real Time Supply Chain**

Source: Boyson, S. & Corsi, T. (2002). Managing the real-time supply chain. Proceedings of the 35th Hawaii international conference on system sciences.

Some of the US manufacturing companies that have seen benefits from using real-time integration in their supply chain are Cisco, SUN Microsystems, and Whirlpool. Real-time information has allowed Cisco to improve their per employee revenue by almost three times that of their competitors, lower their cost of doing business by $560 million per year, and by integrating suppliers earlier in the ordering process, the company has reduce the average lead time from 40 days to 7-21 days (Boyson, 2002). SUN implemented their real-time business strategy to cut five weeks out of fourteen week product cycle times and 25% of

the product's cost (Boyson, 2002). Whirlpool Corporation is able to operate with lower inventory levels, because real-time information has improved the accuracy of their forecasts (D'Antoni, 2003). According to the Information Week survey,40% of the small companies, over half the medium sized, and one third of the large companies have seen their supply chain become more efficient with the use of real time information (D'Antoni, 2003). This information is portrayed in Figure 6.

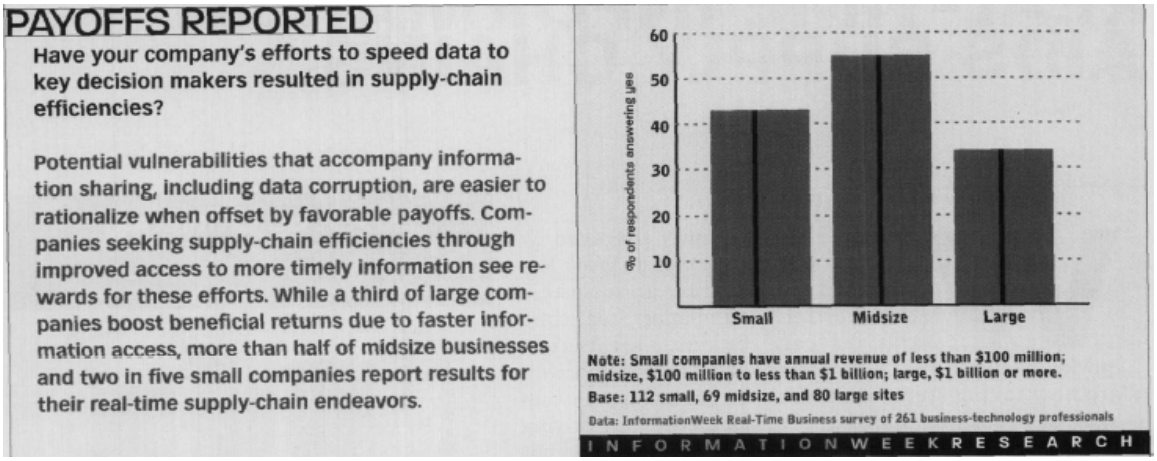


**Figure 6: Information Week Real Time Survey Benefits Results**
Source: D'Antoni, H. (2003). Behind the numbers: real-time aids supply chains. *Information Week*, 936,71-72.

There are technological and also trust challenges that will keep a company from seeing the business benefits these companies have generated. According to Krizner (2001) the integration challenges are primarily technical in nature, such as:

- "End users may define processes and data differently from their supply chain partners."
- "Companies have invested millions of dollars in ERP systems. They will hang on to that system and try to leverage technology against it."
- "Other companies have older legacy systems. The trick here is to get these systems to talk to other systems, something they were not built to do." **Source (Krizner, 2001).**

A company's business partners are able to share real-time information is another possible opportunity, but in Figure 7, it illustrates that about half of these companies'

partners do not have this capability. Not only are there technological problems there are also trust issues. According to the Information Week study, nearly a third of companies report that business partners will not share information, which is hindering the systems ability to manage data in real-time. These results can be seen in Figure 8.

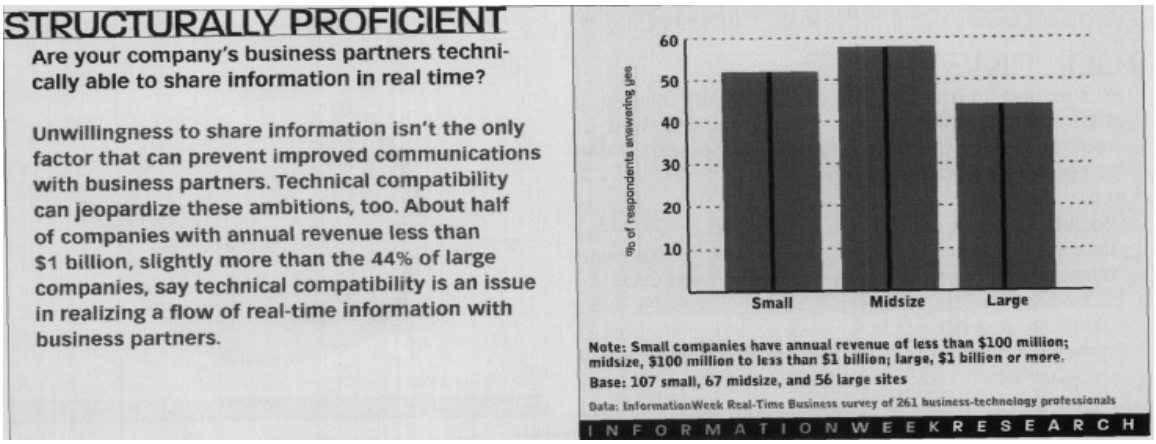


**Figure 7: Information Week Real-Time Study- Technology Challenges**
Source: D'Antoni, H. (2003). Behind the numbers: real-time aids supply chains. *Information Week*, 936,71-72.

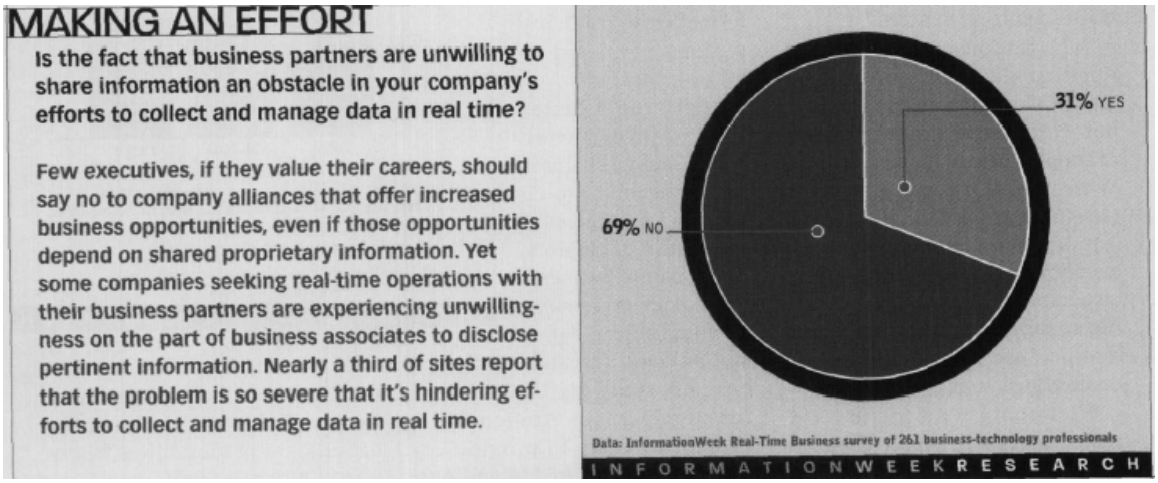


**Figure 8: Information Week Real-Time Survey- Trust Issues**
Source: D'Antoni, H. (2003). Behind the numbers: real-time aids supply chains. *Information Week*, 936,71-72.

## 2.7 E-Business and Supply Chain Management

A supply chain encompasses all activities employeed with the flow of materials, information and services from raw material supplies, through product or service processing facilities and warehouses to the end customer (Gibson, 2004). These activities are then split into two basic processes: supply chain planning and supply chain execution (Worthington, 2002). Supply chain planning includes advanced scheduling, demand forecasting, manufacturing planning, and transportation planning (Worthington, 2002). All of these are necessary components for the effective coordination of manufacturing and supply efforts based on individual customer orders (Worthington, 2002). Supply chain execution includes order planning, production, replenishment, distribution management, and logistics (Worthington, 2002). All of these factors ensure that orders smoothly flow through the system, from the supplier through to the manufacturing operation, and finally to the end customer (Worthington, 2002). The goal of a supply chain is to increase efficiency through automated business processes that balance supply and demand, and this can be achieved through the use of e-business tools.

There are many recent developments in e-business tools to address supply chain challenges. For example, there are vendors that provide specific inventory tracking, distribution, and warehousing tools, such as smart tags (Worthington, 2002). There is also software that uses a web browser based system to enable companies to track customized products at the unit level, and which provides customers and manufacturers a real-time view into any part of the process (Worthington, 2002). For smaller companies, there is software that enables companies to handle procurement, fulfillment, and inventory management. For e-procurement there are software tools that enable a purchasing agent to send a “bot” onto

the web to look for certain products. This "bot" will then report every morning with a list of the new prices it has found for that certain product without the purchasing agent having to do anything (Worthington, 2002).

Through the use of e-business, a company can reduce cost and reduce the time it takes to get the final product to the end-customer. The availability of customer data has the ability to overcome various inefficiencies such as excess inventories, poor capacity utilization, and higher transportation and distribution costs (Gibson, 2004). This is because supply chain partners will tend to produce too little or too much due to a lack of real-time information. According to Gibson, "Real time connectivity will increase among tier 1 suppliers and the lower tiers through data sharing to offset the lack of real-time information." Also, after implementing an e-business supply chain management (SCM) strategy it will allow a company to grow and develop other e-commerce related businesses, and to promote further improvements in operation through state-of-the-art methodologies (Power, 2002).

While many companies are working on a variety of Web-based supply chain management systems, the reality is that much of the work requires a large amount of custom coding, so it will be a while before a cost effective turnkey solution is created (Worthington, 2002). Other challenges companies face are creating an interoperable and interchangeable system, creating standards for item descriptors, and creating a standard SCM database (Worthington, 2002).

Organizational change is often a challenge in adapting a new technology. If people (and the way their traditional vertical accountability and authority are organized) throughout the supply chain do not adapt to the potential offered by the internet and B-to-B technology, the savings expected by this change will continue to remain unrealized (Gibson, 2004).

Another factor that companies might face is to develop a culture of trust. It is argued that a culture change is required in order to establish real partnerships through which information can be exchanged to the mutual benefit of all supply chain participants (Towill, 1997). These are just a few examples of the challenges that a company might face when implementing e-business in their SCM.

## 2.8 Structure of B-to-B

The structure of the internet marketplace has four layers according to Mahadevan (2000) which are:

1. "Infrastructure layer- the infrastructure needed to conduct business over the internet."
2. "Applications layer- support systems for the internet economy through a variety of software applications that can exploit the infrastructure."
3. "Intermediary layer-host of companies that participate in market making process."
4. "Commerce layer- companies that conduct business in this overall environment."

**Source: Mahadevan, 2000**

The commerce layer is where B-to-B e-commerce would fall into, and it is important to note that B-to-B would not exist without the first three layers within this framework.

### 2.8.1 Market Structures

Within this internet economy, there is an emerging market design that is divided into three structures according to (Mahadevan, 2000). The first structure is a portal, and this type of company funnels customers to websites managed by product/service providers. Portals

also build a community of consumers by supplying information about products (Mahadevan, 2000).

Market maker is the second emerging structure in the internet community. This structure is similar to portals because it develops a community of customers and suppliers based on certain products and services. Market makers differ from portals because they participate in a variety of ways to facilitate business transactions between the buyer and supplier, and they have a higher degree of domain knowledge. Also, they can provide value to the suppliers and customers through systems of guaranteed security and trust (Mahadevan, 2000).

The third structure is product/service providers. Basically all the companies in this structure do is sell their products directly to their customer. According to Mahadevan (2000), "This type of company would have an extensive customization to their information system and business processes to accommodate customer requirements on line." This type of structure would allow manufacturing companies to increase their customer service level.

### 2.8.2 New B-to-B Market Structures

The three structures just discussed can be found in B-to-C or B-to-B e-business, but new market structures have been created in the B-to-B market more recently which is shown in Table 8.

**Table 8: New B-to-B Market Structures**

| Name of Market Structure | Examples |
|---|---|
| Extranet | www.citrix.com |
| Trading Partner Network(TPN) | www.geis.com |
| Web EDI | www.geis.com |
| Buyer Centric Private Market | www.ariba.com |
| Supplier Centric Private Market | www.verticalnet.com |
| Consortia Market Place | www.aeroexchange.com |
| Seller-Oriented(Forward) Auction Sites | www.fedsales.gov |
| Buyer Oriented (Reverse) Auction Sites | www.freemarkets.com |
| Neutral Auctions | www.assettrade.com |
| Exchanges | www.eSTEEL.com |
| Catalogue Aggregators | www.sciquest.com |
| On-line Community | www.dentalarena.com |

Source: Mahadevan, B. (2003). Making sense of emerging structures in B-to-B e-commerce. *California Management Review*, 46(1), 86-100.

According to Mahadevan (2003), these 12 market structures fall under 3 categories; collaborative market mechanisms, quasi-market mechanism, and neutral market mechanism. The collaborative mechanisms are structures that are enabled when inter-organizational information systems are networked through the internet to share vital data of interest to the network members. The structures that fall into this category are extranet, trading partner network (TPN), and web EDI.

Quasi-market mechanism is one or a small group of buyers or sellers that will initiate the marketplace, host, monitor, enroll market participants, and moderate the market behavior (Mahadevan,2003). This category will have bias towards the buyers or sellers, because one of them does the rule governing of the marketplace and membership. Buyer and seller centric marketplaces, seller and buyer oriented auctions, and consortia marketplaces are the structures that make up this category (Mahadevan, 2003).

The third B-to-B structure category is neutral market mechanisms. These mechanisms are a large number of both buyers and suppliers that participate in these markets,

which are neutral in power towards both sides. The structures that fall under this category are neutral auctions, exchanges, catalogue aggregators, and online communities.

### 2.8.3 Classification Factors for Market Structures

To determine what classification the market structures were, Mahadevan (2003) used factors such as fragmentation and asset specificity. Degree of Fragmentation is the degree of control or influence the buyers or suppliers exert in the marketplace. When the degree is high on both sides, the market tends to be more open and competitive. When there is less fragmentation, there is an opportunity for a control-oriented market, but when it is very low, organizations tend to collaborate more.

The second factor used to classify these structures is asset specificity. This is a function of the costs of setting up a relationship between two market participants in order to manage business transactions in a cost-effective manner (Mahadevan, 2003). The higher the asset specificity is, the more collaborative and better off the market participants are. With medium specificity, using quasi-mechanism that blends both collaboration and competition is a viable alternative, but at low specificity, a relationship is based on cost benefits for the supplier and buyer (Mahadevan, 2003). Figure 9 shows what structures to use in certain degrees of fragmentation and levels of asset specificity. It illustrates that neutral market structures are used during high fragmentation for medium and low asset specificity. This indicates that other factors are needed to classify neutral market structures.

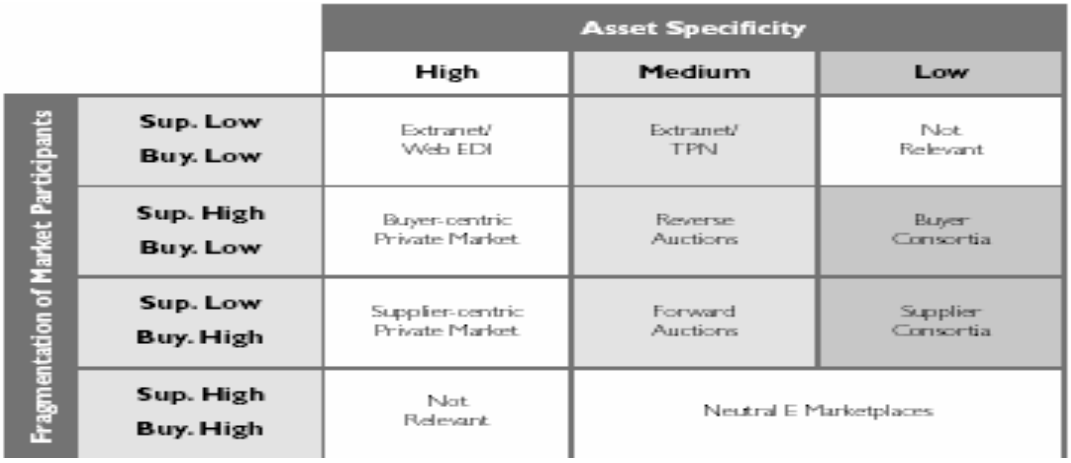


**Figure 9: E-business Market Structures Based on Asset Specificity & Market Fragmentation**

Source: Mahadevan, B. (2003). Making sense of emerging structures in B-to-B e-commerce. *California Management Review*, 46(1), 86-100.

### 2.8.4 Classification Factors for Neutral Market Structures

The two extra factors that are used to classify neutral market structures are complexity of product description and value assessment. Complexity of product description relates to how much information a buyer needs to understand the functionality and specifications of the product (Mahadevan, 2003). For complex descriptions Mahadevan suggests online communities and catalogues and for more moderate description exchanges and auctions.

The second factor needed to classify neutral market items is the complexity of the value assessment. Value assessment is the amount of information needed to estimate accurately the item's worth and to either arrive at a price or select items offered at a price (Mahadevan, 2003). The newer and less unique an item is the easier the value assessment is. Products with simple descriptions can still cause it to have a difficult value assessment. This is because price-setting mechanisms can be dynamic from bids and offers, and due to information asymmetry problems (Mahadevan, 2003).

# 3 Methodology

The prior chapter reviewed the literature about e-business and supply chain management to develop an understanding of these two terms. Chapter 3 described what the purposes and objectives of this research are. This chapter also described the methodology that the study followed to accomplish these objectives

## 3.1 Research Purpose

1 Define what are the business-to-business transactions being used in the US textile manufacturing supply chain.

2 Determine how US textile manufacturers are using e-business initiatives in supply chain management when dealing with business-to-business transactions.

3 Determine what benefits and barriers are US textile manufacturers facing when implementing e-business initiatives into their supply chain.

## 3.2 Research Objectives

RO1 Develop a definition for supply chain business-to-business transactions in US textile manufacturing.

RO2. Identify if e-business technologies are being used in the current US textile manufacturing supply chain practices that deal with business-to-business transactions.

RO3. Understand what type of data companies are exchanging with each other within the US textile manufacturing supply chain when using business-to-business technology.

RO4. Determine how these data are being used by US textile manufacturers after receiving it.

RO5. Determine how often these companies are exchanging this information.

RO6. Determine the barriers that are hindering the use of business-to-business technology in the US textile manufacturing supply chain.

RO7. Determine the benefits that influence US textile manufacturers to implement business-to-business technology into their supply chain strategy.

RO8. Develop strategies that US textile manufacturers can follow to implement e-business in respect to supply chain management.

## 3.3 Research Design

The research design followed a mixed method approach because it contains the analysis of quantitative and qualitative data. Quantitative and qualitative data were collected through the analysis of secondary sources, open-ended interviews, and case studies. John Creswell defines a mixed method approach as, "one in which the researcher tends to base knowledge claims on pragmatic grounds (e.g., consequence oriented, problem centered, and pluralistic). It employs strategies of inquiry that involve collecting data either simultaneously or sequentially to best understand research problems. The data collection also involved gathering both numeric information (e.g., on instruments) as well as text information (e.g., on interviews) so that the final database represents both quantitative and qualitative information (Creswell, 2003 P.213)." This research method eliminates any bias from using one single method, for the results from one method can influence the other method (Creswell, 2003).

This research design adhered to a sequential exploratory design which is explained in Figure 10. "This model is characterized by an initial phase of qualitative data collection and analysis, which is followed by a phase of quantitative data collection and analysis. Therefore, the priority is given to the qualitative aspect of the study. The findings of these two phases are then integrated during the interpretation phase. The purpose of this strategy is to use quantitative data and results to assist in the interpretation of qualitative findings" (Creswell, 2003 P. 215).

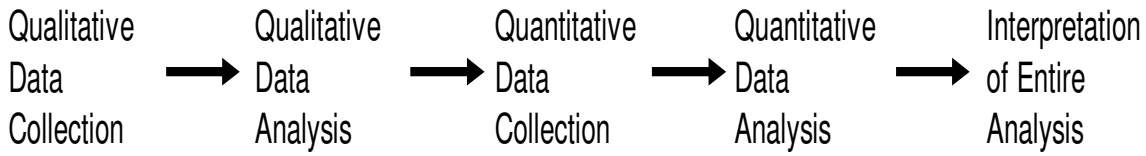


**Figure 10: Sequential Exploratory Design**

Source: Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Method Approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications.

### 3.3.1 Phase I: Analysis of Secondary Sources

The first phase of this study consisted of an analysis of secondary sources. In order to achieve the research objectives, Phase I will first defined what B-to-B transactions are in respect to supply chain management. Second it analyzed how manufacturers are using e-business initiatives when dealing with B-to-B transactions in their supply chain, and third identified the barriers and benefits manufacturers will face when using e-business in respect to supply chain management. These three tasks were completed by the analysis of secondary sources such as:

1. Textbooks, Trade, and Scholarly journals related to supply chain management;
2. Government data reports from the US Department of Commerce and US Census Bureau;
3. Financial records of US textile manufacturing companies such as 10K reports and from Hoovers database;
4. The survey data collected from Christine Cagle's ongoing research.

Then, the results from Phase I were used to determine which subjects are most relevant to manufacturers, so that a structured open-ended interview instrument could be developed for Phase II. Phase I followed an inductive theory approach which is described in Figure 11. In Phase I, there were no interviews or observations. Instead, the information was gathered from secondary sources. This study will replace open-ended questions to participants with the analysis of the secondary sources for developing questions. These questions will be based on the generalizations and results from other studies published in the past about e-business.

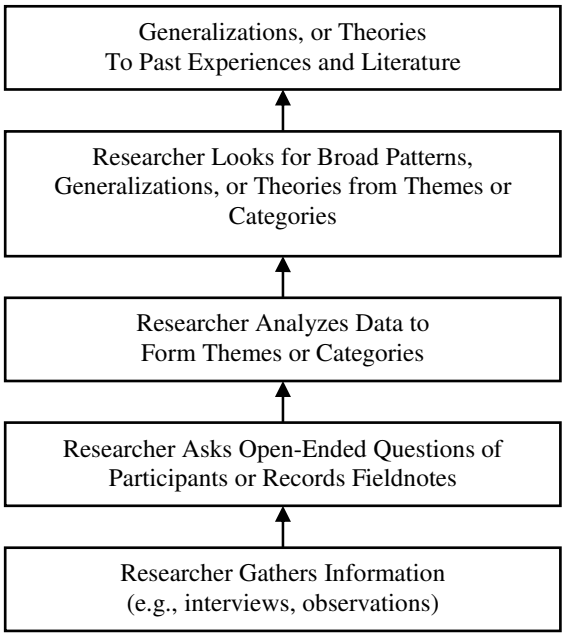


**Figure 11: Inductive Theory for Mixed Methods Research**
Source: Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Method Approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications.

### 3.3.2 Phase II: Analysis of Primary Data

The second phase of this study consisted of collecting primary data through the use of open-ended interviews and case studies. Phase II followed a deductive logic theory which is explained in Figure 12. This phase II identified the current and future business practices being performed with e-business in relation to the US textiles supply chain, and discovered the present barriers and benefits that the industry faces when dealing with e-business and supply chain management.

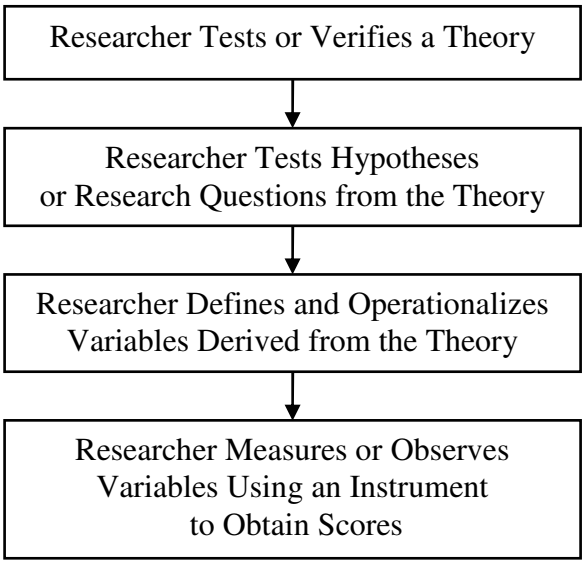


**Figure 12: Deductive Theory for Mixed Method Research**
Source: Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Method Approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications.

The first part of the phase II analysis was open-ended interviews. These interviews were conducted with companies that meet the requirements described in the sample section of this paper. Open-ended interviews answered the study's research objectives along with the phase I analysis since this instrument allows the researcher to ask for the informant's opinion about their business strategies (Tellis, 1997). These interviews showed if US textile manufacturers are using e-business when dealing with b-to-b transactions in their supply chain. The interviews were conducted according to the interviewee's schedule and availability, within the time frame allotted for the interview phase of the study. They were conducted in person if the interviewee's schedule allows them to. If not, these interviews took place over the phone or email.

From the results of these interviews, companies were selected to conduct in depth case studies to understand how e-business supply chain projects are justified and implemented into a company's business strategy. According to Creswell, case studies are

"studies in which the researcher explores in depth a program, an event, an activity, a process, or one or more individuals. The case(s) are bounded by time and activity and researchers collect detailed information using a variety of data collection procedures over a sustained period of time". Case studies are important because they allow for more detailed descriptions of solutions and can focus on the areas that textile executives indicated to be of most interest through open-ended interviews. The information for case studies can be gathered by six sources: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts (Yin, 1994). The strengths and weaknesses of these six sources are broken down in Figure 13. This study used documentation, archival records, interviews, and direct observations.

| **Source of Evidence** | **Strengths** | **Weaknesses** |
|---|---|---|
| Documentation | • Stable-can be reviewed repeatedly<br>• Unobtrusive- not created as a result of the case study<br>• Exact- contains exact names, references, and details of an event | • Retrievability- can be low<br>• Biased selectivity if collection is incomplete<br>• Reporting bias- reflects (unknown) bias of author<br>• Access- may be deliberately blocked |
| Archival Records | • (same as above for documentation)<br>• precise and quantitative | • (same as above for documentation)<br>• accessibility due to privacy reasons |
| Interview | • targeted- focuses directly on case study topic<br>• Insightful- provides perceived causal inferences | • Bias due to poorly constructed questions<br>• Response bias<br>• Inaccuracies due to poor recall<br>• Reflexivity- interviewee gives |

| | | |
|---|---|---|
| | | what the interviewer wants to hear |
| Direct Observations | • Reality- covers events in real time<br>• Contextual- covers context of event | • Time –consuming<br>• Selectivity- unless broad coverage<br>• Reflexivity- event may proceed differently because it is being observed<br>• Cost- hours needed by human observers |
| Participant Observation | • (Same as above for direct observations)<br>• Insightful into interpersonal behavior and motives | • (Same as above for direct observations)<br>• Bias due to investigator's manipulation of events |
| Physical Artifacts | • Insightful into cultural features<br>• Insightful into technical operations | • Selectivity<br>• Availability |

**Figure 13: Six Sources of Evidence: Strength and Weaknesses**
**Source:** Yin, R. (1994). *Case study research: Design and methods* (2nd ed.). Thousand Oaks, CA: Sage Publishing.

## 3.4 Sample Selection

A convenience sample was used based on the following criteria:

1. Textile manufacturers that are under one of the following NAICS codes:

    a. Yarn Texturing, Throwing, and Twisting (NAICS 313112)

    b. Broadwoven Fabric (NAICS 313210)

    c. Schiffli Machine Embroidery (NAICS 313222)

    d. Weft Knit Fabric (NAICS 313241)

    e. Broadwoven Fabric Finishing (NAICS 313311)

    f. Fabric Coating (NAICS 313320)

g. Yarn Spinning (NAICS 313111)

h. Thread (NAICS 313113)

i. Narrow Fabric (NAICS 313221)

j. Nonwoven Fabric (NAICS 313230)

k. Other Knit Fabric and Lace (NAICS 313249)

l. Textile and Fabric Finishing (Except Broadwoven Fabric) (NAICS 313312)

2. The company has locations in the Southeastern US, (VA, NC,TN, SC, GA)

3. Involved with B-to-B e-business or considering to be.

## 3.5 Data Collection

From the data collected in Phase I of this research, an open-ended interview instrument was created. The methodology followed to create this instrument was to gather secondary sources that contained subject matter that was related to the research objectives. Key questions where then formed from the trends that were identified in these articles. Using this interview instrument, data was collected from 10 to 15 companies that were scheduled at a time and place convenient to the interviewer within the time frame specified by the study. Secondary data about the company was collected prior to the interview. Based on the results of the interviews, case studies were set up with cooperating companies to develop an in depth understanding of how e-business supply chain projects are justified and implemented within the US textile industry.

## 3.6 Data Analysis

The case studies were analyzed by using information collected from the interviews along with the secondary data to aid in the development of an implementation plan for the chosen e-business initiative with respect to supply chain management. The results of Phase I ( secondary sources) along with interviews (Phase II A) and case studies (Phase II B) were used to determine the results with respect to the research objectives.

# 4 Results

The results chapter is broken down into two phases. Phase I consisted of an analysis of secondary sources, and Phase II was a gathering of the primary data collected from this study. Phase II is broken down into two sections, open ended interviews and case studies.

## 4.1 Phase I: Analysis of Secondary Sources

Phase I collected secondary data to define what are B-to-B transactions are in respect to supply chain management (RO1). Phase I analyzed how manufacturers are using e-business initiatives when dealing with B-to-B transactions in their supply chain (RO2), and identified the barriers and benefits manufacturers will face when using e-business with respect to supply chain management (RO6 & RO7). Also, this phase analyzed what economic factors and calculations are used to justify an e-business supply chain project.

### 4.1.1 E-business and Supply Chain Management

E-business is defined as doing business online, finding and interacting with customers, communicating with business partners and suppliers, and developing new products and markets (Worthington, 2002). As discussed in Chapter 2, e-business is separated into two areas, business-to-business (B-2-B) and business-to-customer (B-2-C), and this study focuses on the B-2-B aspect of e-business. Figure 14 illustrates the difference between B-2-B and B-2-C e-business activities in the textile supply Chain. B-2-B transactions are all the business activities that are conducted between two businesses, for example the exchanging of cotton fiber information between the fiber producer and yarn

formation manufacturer. B-2-C e-business is the transactions conducted between a business and the end consumer.

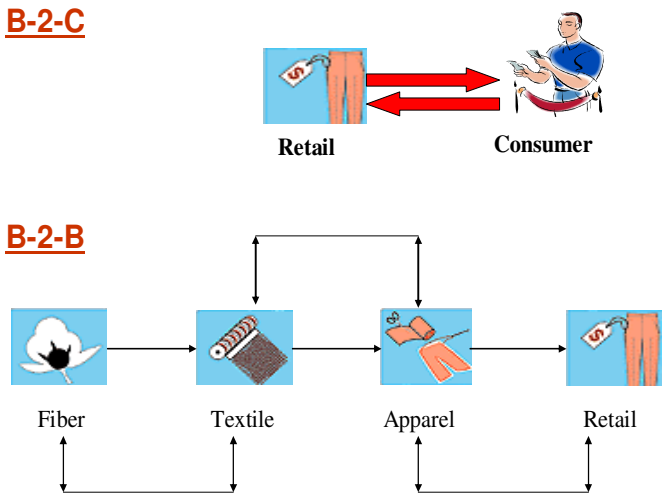


**Figure 14: B-2-C vs. B-2-B E-business**
**Source: Lauer, 2006**

According to the US Census 2003 Annual Manufacturing Survey, 21.2% of the value of shipments by US manufacturers was conducted by B-2-B e-business. The percentage of value of shipments conducted by US manufacturers by e-business has increased from 18.1% in 1999 to 21.2% in 2003, as shown in Figure 15. The US Census Bureau's e-commerce measures include the value of goods and services sold online, whether over open networks such as the internet or over proprietary networks running systems such as Electronic Data Interchange (EDI) (US DOC, 2004). The value of shipments conducted by e-business for the US manufacturing has increased by 15.5% over this five year period, while the total value of this industry has decreased by 1.2% over the same time period.

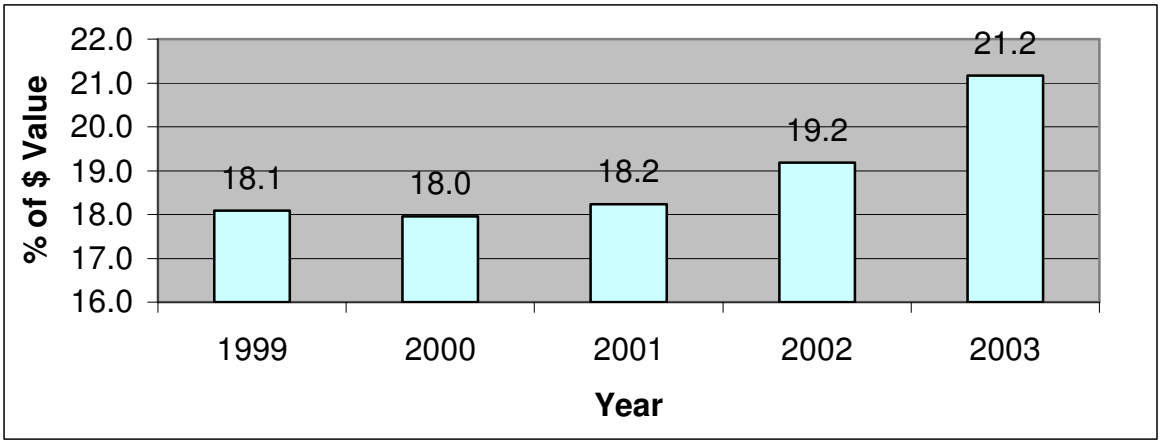


**Figure 15: % of US $ Value of Shipments that was Conducted by B-2-B e-business for the Manufacturing Industry 1999-2003**

Source: US Census Bureau. (1999-2003). E-commerce multi sector report. Retrieved August 29, 2005, from E-stat website http://www.census.gov/eos/www/archives.html

When comparing the total US manufacturing industry to the textile manufacturing sector, the increased use of e-business is not following the same rate. The percentage of value of shipments conducted by e-business for US textile manufacturers was 15.3% in 1999 and decreased to 14.8% in 2003, as shown in Figure 16. This percentage has remained basically the stagnant for this five year period while the total value of shipments for this sector has decreased by 15.6%.

There are two NAICS codes that make up the textile manufacturing industry: 313-Textile Mills and 314-Textile Product Mills. The 313 sector accounts for 60% of the value shipments compared to the 40% for the 314 sector. The percentage of value of shipments for the 313 sector has dropped by 2.5% from 1999 to 2003, but the 314 sector's percentage has remained at 23% from 2001-2003.

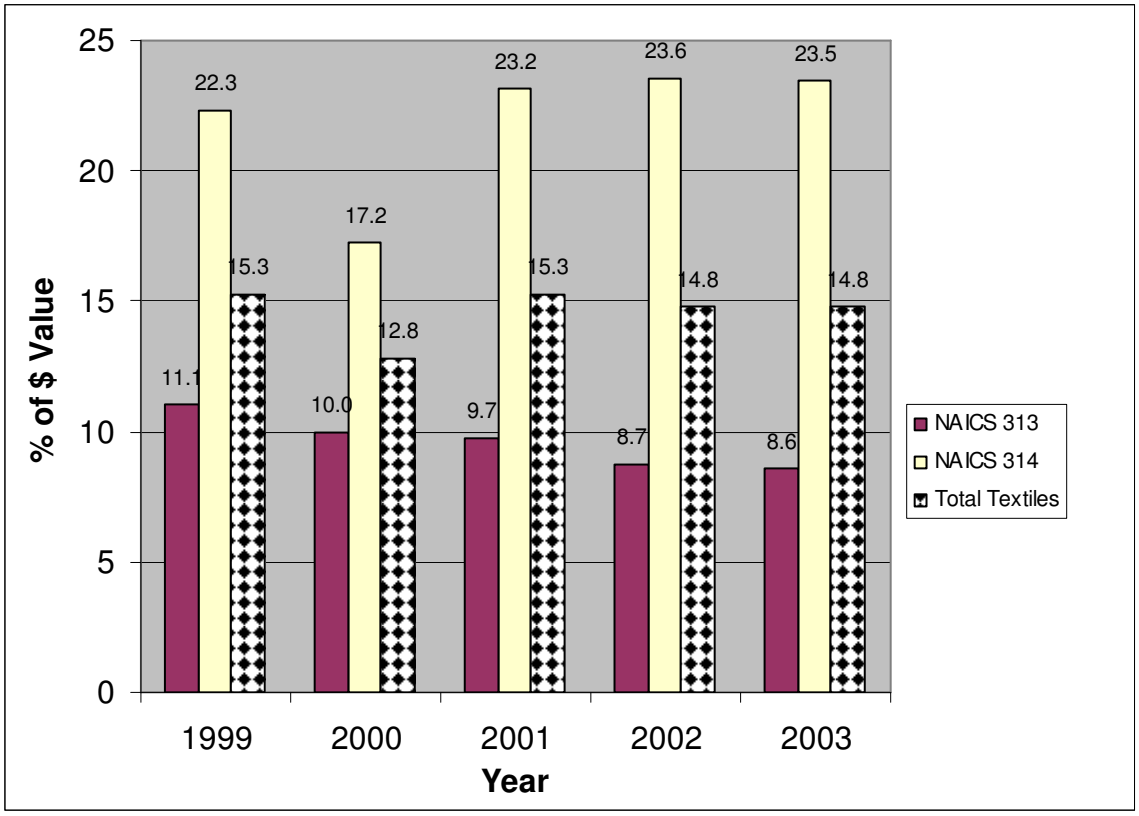


**Figure 16: % of US $ Value of Shipments that was Conducted by B-2-B Technology for the Textile Manufacturing Industry 1999-2003**

Source: US Census Bureau. (1999-2003). E-commerce multi sector report. Retrieved August 29, 2005, from E-stat website http://www.census.gov/eos/www/archives.html

The European Union has also started to collect information on what sectors of their economy are using e-business to conduct their business processes. This study is called European e-business Watch. This study was able to create an e-business scoreboard for 17 sectors in Europe (European E-business Watch, 2004). The E-Business Scoreboard is based on indexed values. These values take into account the percentages (diffusion rates) from all sectors and show how a specific sector differs from the all-sector-average (European E-business Watch, 2004). An index value is based on mean values and standard deviations (European E-business Watch, 2004). Each sector's e-business value is based on the 16 indicators shown in Table 9.

**Table 9: European Study E-business Indicators**

| Indicator |
|---|
| 1. LAN use |
| 2. Internet connectivity (compound indicator in itself) |
| 3. Remote access to company network |
| 4. Wireless access to company network |
| 5.Intranet diffusion |
| 6. Use of online technology to track working hours and/or production time |
| 7. Use of ERP systems |
| 8. Perceived impact of ebusiness on internal work processes |
| 9. Enterprises purchasing at least 5% of their supplies online |
| 10. Use of SCM systems |
| 11. Integration of IT system with suppliers |
| 12. Electronic exchange of documents with suppliers |
| 13. Enterprises maintaining a website with a content management system |
| 14. Use of CRM systems |
| 15. Enterprises selling at least 5% of their goods & services online |
| 16. Enterprises with an online sales system that offers secure transactions capability |

Source: European E-business Watch (2004). European e-business report 2004 edition. Retrieved October 29, 2005, from European e-business Watch website http://www.ebusiness-watch.org/resources/documents/eBusiness-Report-2004.pdf

Textile, clothing, and footwear is one of the sectors included in this study, and this sector is broken into three NACE divisions. The NACE are general industrial classification of economic activities within the European communities. The divisions include companies that manufacture textile and textile products, manufacturers of wearing apparel, dressing, and dyeing fur, and manufacturers of leather and leather products. All of these divisions include sub divisions and these sub-divisions are listed in Figure 17.

| NACE Rev. 1 Division | Group | Activity |
|---|---|---|
| 17 | | Manufacture of textile and textile products |
| | 17.1 | Preparation and spinning of textile fibres |
| | 17.2 | Textile weaving |
| | 17.3 | Finishing of textile |
| | 17.4 | Manufacture of made-up textile articles except apparel |
| | 17.6 | Manufacture of knitted and crocheted fabrics |
| | 17.7 | Manufacture of knitted and crocheted articles |
| 18 | | Manufacture of wearing apparel, dressing and dyeing of fur |
| | 18.1 | Manufacture of leather clothes |
| | 18.2 | Manufacture of other wearing apparel and accessories |
| 19 | | Manufacture of leather and leather products |
| | 19.3 | Manufacture of footwear |

**Figure 17: Breakdown of Textile Companies Included in the European E-business Study**

Source: European E-business Watch (2004). European e-business report 2004 edition. Retrieved October 29, 2005, from European e-business Watch website http://www.ebusiness-watch.org/resources/documents/eBusiness-Report-2004.pdf

This study includes an analysis of the textile sector in a much greater detail than the US census data. The textile industry received the third lowest index score of 38 out of 100 when the study compared the different sectors as shown in Figure 18. One of the reasons for the low index is the industry is dominated by SMEs, which are concentrated in regional clusters (European Commission, 2004). There are also cultural barriers, such as strong adherence to traditional production and trading partners (European Commission, 2004).

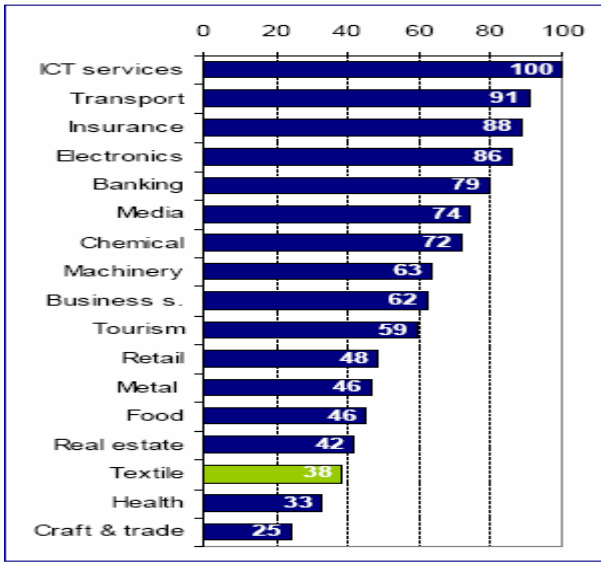


**Figure 18: E-business Index Rankings for European Sectors**

Source: European Commission. (2004). Electronic Business in the textile, clothing and footwear industries sector report. Retrieved October 29, 2005, from European e-business Watch website http://www.ebusiness-watch.org/resources/textile/SR01-I_Textile.pdf

The results of these studies explain that there are textile manufacturers using and implementing e-business technology to handle B-2-B transactions. So what part of the business does this e-business technology fall into? Hodge and Cagle (2004) developed a taxonomy of e-business models based on how the technology is used. This taxonomy, represented in Figure 19, shows there are seven different e-business models.

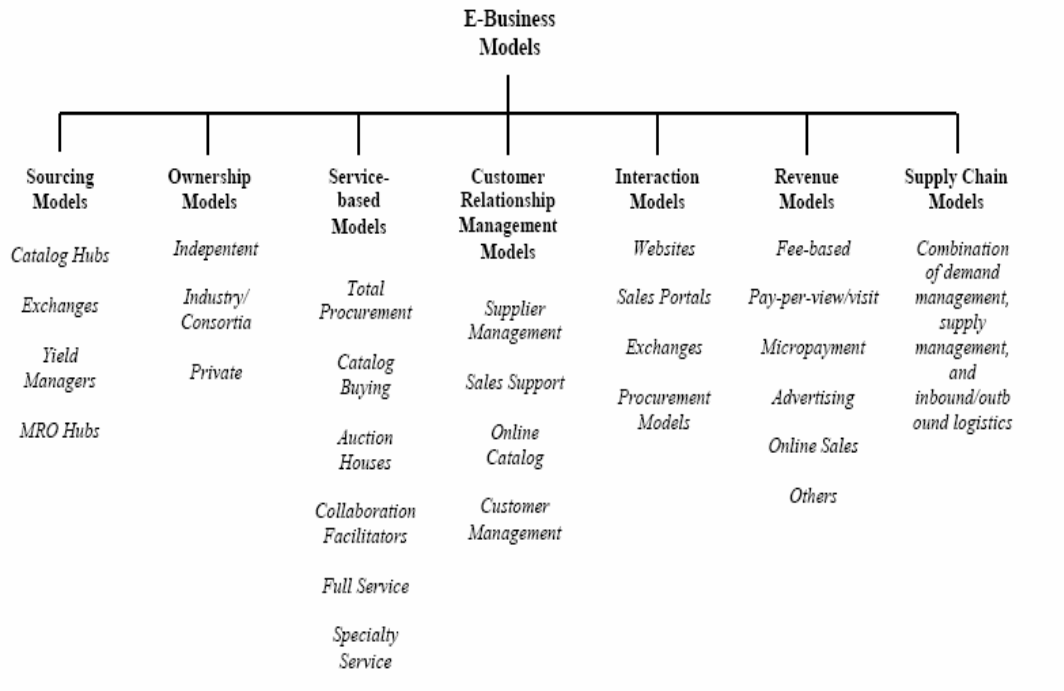


**Figure19: Taxonomy of E-business Models**

Source: Hodge, G. & Cagle, C. (2004). Business-to-business e-business models: classification and textile industry implications. AUTEX Research Journal, 4(4), 211-227.

A supply chain encompasses all activities employeed with the flow of materials, information and services, from raw material supplies through product or service processing facilities, and warehouses to the end customer (Gibson, 2004). These activities are then split into two basic processes: supply chain planning and supply chain execution as shown in Figure 20 (Worthington, 2002). Supply chain planning includes activities such as advanced scheduling, demand forecasting, manufacturing planning, and transportation planning

(Worthington, 2002). All of these are necessary components for the effective coordination of manufacturing and supply efforts based on individual customer orders (Worthington, 2002). Supply chain execution includes order planning, production, replenishment, distribution management, and logistics (Worthington, 2002). All of these factors ensure that orders smoothly flow through the system, from the supplier through to the manufacturing operation, and finally to the end customer (Worthington, 2002).

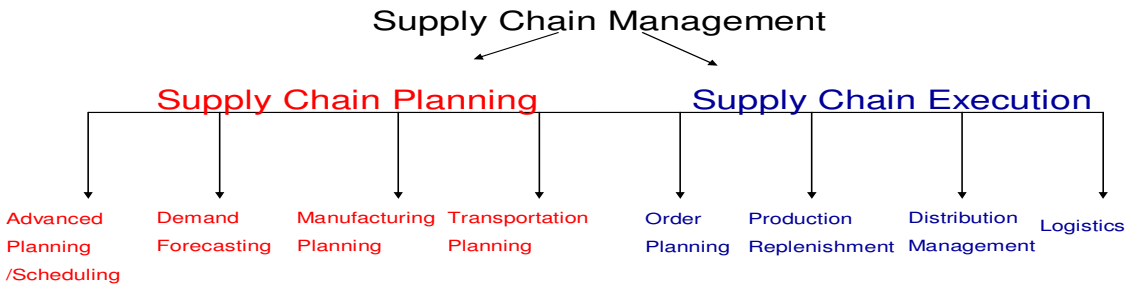


**Figure 20: Supply Chain Planning & Execution Activity**
Source: Worthington S. & Boyes, W. (2002). *E-business in manufacturing: putting the internet to work in the industrial enterprise*. Research Triangle Park, NC : Instrumentation, Systems and Automation Society.

Based on the definitions of supply chain and B-2-B e-business, this study has developed a definition for B-2-B supply chain e-business transactions. B-2-B supply chain e-business transactions are when two corporations exchange information pertaining to:

- Supply Chain Planning Activities
  - Advanced Planning/Scheduling
  - Demand Forecasting
  - Manufacturing Planning
  - Transportation Planning
- Supply Chain Execution Activities:
  - Order Planning
  - Production Replenishment
  - Distribution Management
  - Logistics

over an electronic network that is integrated with both corporations' internal enterprise system. This definition does not include e-mail and fax procedures that incorporate a manual step to input data into a company's internal system.

### 4.1.2 B-2-B Supply Chain Initiatives

The results from the European study described in prior paragraphs pointed out there were textile manufacturers using e-business in general, but the results did not indicated if they were using it for B-2-B supply chain transactions. Figure 21 is a graph that compares the European textile, clothing, and footwear industry's index rating in four dimensions. The information provided by Figure 21 shows these industries' index ratings are below average in all of the dimensions when compared to the other sectors.

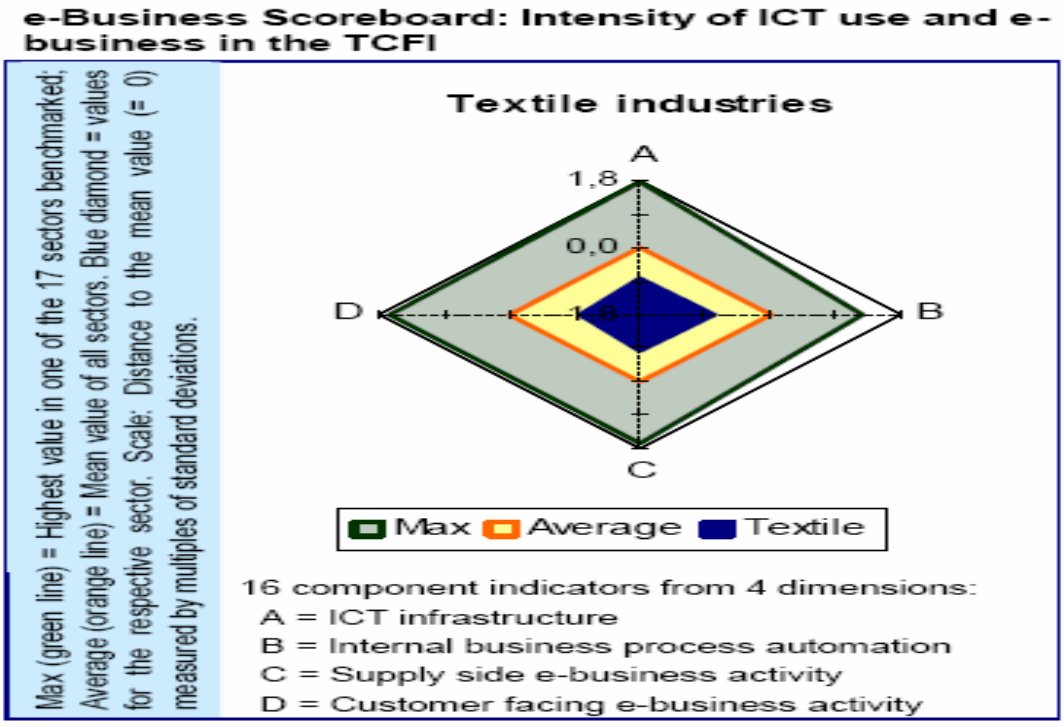


**Figure21: European Textile Industry's E-business Scorecard**

Source: European Commission. (2004). Electronic Business in the textile, clothing and footwear industries sector report. Retrieved October 29, 2005, from European e-business Watch website http://www.ebusiness-watch.org/resources/textile/SR01-I_Textile.pdf

The textile industry was below average in the e-business supply side due to the lack of B-2-B connectivity in its supply chain management. Table 10 compares each sector by the percentage of firms and employees that are using B-2-B supply chain connectivity. Only 23% of the textile related firms exchange documents online with their suppliers, which accounts for 37% of the employees for this sector. Both of these percentages are two of the lowest rating for all the sectors. In these sectors 1% of the firms have their IT systems integrated with their suppliers and use a supply chain management system. This is why the textile, footwear, and clothing sectors are in the lowest tier for having B-2-B connectivity in its supply chain.

**Table 10: European Textile, Footwear, & Clothing Industry B-2-B Connectivity %**

| | B2B connectivity / SCM | | | | | |
|---|---|---|---|---|---|---|
| | Exchange documents online with suppliers* | | IT system integrated with supplier | | Use SCM system | |
| | firms | empl. | firms | empl. | firms | empl. |
| **By sector (EU-5)** | | | | | | |
| Textile, footwear, clothing | 23 | 37 | 1 | 2 | 1 | 7 |
| Chemical industries | 39 | 44 | 4 | 6 | 4 | 13 |
| Electronics | 41 | 46 | 5 | 12 | 2 | 10 |
| Transport equipment | 40 | 56 | 5 | 14 | 3 | 19 |
| Craft & trade | 36 | 39 | 5 | 6 | 2 | 3 |
| Retail | 34 | 42 | 9 | 11 | 5 | 5 |
| Tourism | 33 | 39 | 8 | 7 | 2 | 3 |
| ICT services | 53 | 51 | 8 | 19 | 2 | 11 |
| Business services | 29 | 45 | 1 | 6 | 1 | 6 |
| Health & social services | 27 | 30 | 4 | 3 | 0 | 1 |

Base (100%): all enterprises / *enterprises with Internet access. EU-5 = DE, ES, FR, IT, UK. N=4516 for EU-5 total and ~500 per sector. Weighting: "firms" = % of firms; "empl." = enterprises comprising ...% of employees (in the respective sector / country). Reporting period: March/November 2003.

Source: European Commission. (2004). Electronic Business in the textile, clothing and footwear industries sector report. Retrieved October 29, 2005, from European e-business Watch website http://www.ebusiness-watch.org/resources/textile/SR01-I_Textile.pdf

To break Table 10 down into more specific B-2-B activities, the European study analyzed the percentage of textile manufacturers that perform demand forecasting and

inventory management online. Five percent of the firms in this sector located in EU-5 use online technologies to perform collaborative demand forecasting and capacity/inventory management (Table 11). The results from this table show that the majority of companies that are using collaborative technology are the larger ones. E-business can be really useful only when the supply chain partners agree on issues such as product description or the order/payment process to be described (European Commission, 2004). Without this, there is the risk that a company's information system will not understand the data sent by their trading partners.

**Table 11: B-2-B Collaborative Activities for European Textile, Footwear, & Clothing Companies**

*Exhibit 2-26: Use of online technologies (other than free text e-mail) for business processes between companies (2003)*

| | Collaborative demand forecast | Capacity / inventory management |
|---|---|---|
| **Sector total (EU-5)** | | |
| % of employment | 9 | 10 |
| % of enterprises | 5 | 5 |
| 0-9 employees | 5 | 3 |
| 10-49 employees | 5 | 7 |
| 50-249 employees | 10 | 13 |
| 250+ employees | 14 | 12 |

Source: European Commission. (2004). Electronic Business in the textile, clothing and footwear industries sector report. Retrieved October 29, 2005, from European e-business Watch website http://www.ebusiness-watch.org/resources/textile/SR01-I_Textile.pdf

Collaborative Planning, Forecasting and Replenishment (CPFR®) is a business practice that combines the intelligence of multiple trading partners in the planning and fulfillment of customer demand (VICS, 2004). This was the development of a single, shared forecast that supported the joint plans of trading partners in the supply chain and drove their mutual replenishment activities (VICS, 2004). Clear performance measures were defined and risk was clarified so that partners faced defined financial consequences when agreements

were not met (VICS, 2004). Incentives were used to motivate collaborative, cooperative behavior and to share the benefits as waste was eliminated from the supply chain and desired results were achieved (see Figure 22 for the complete VICS process model).


**Figure 22: VICS Process Model**

Source: Voluntary Interindustry Commerce Standards Association, (2004). CPFR: an overview. Retrieved October 20, 2005, from VICS web site http://www.cpfr.org

$TC^2$ (2001) has developed a nine step process to implement CPFR in a supply chain, and which is stated below

- "Step 1 - Front-end agreement: Participating companies identify executive sponsors, agree to confidentiality and dispute resolution processes, develop a scorecard to track key supply chain metrics relative to success criteria, and establish any financial incentives or penalties."
- "Step 2 - Joint business plan: The project teams develop plans for promotions, inventory policy changes, store openings/closings, and product changes for each product category."

- "Steps 3-5 - Sales forecast collaboration: Retailers and suppliers share consumer demand forecasts, and identify exceptions that occur when partners' plans do not match, or change dramatically. They resolve exceptions by determining causal factors, adjusting plans where necessary."
- Steps 6-8 Order forecast collaboration: Retailers and suppliers share replenishment plans, identifying and resolving exceptions.
- "Step 9 - Order generation/delivery execution: Results data (POS, orders, shipments, on-hand inventory) is shared, and forecast accuracy problems, overstock/under stock conditions, and execution issues are identified and resolved."

**Source: TC², 2001**

In order for this to be an e-business initiative, the CPFR information must be shared over an electronic network such as the internet. VICS has compiled a table of electronic standards a company must have implemented in order to perform CPFR. These standards are listed in Table 12. It shows the types of standards a company can use to share this information. Two of these standards, UNI/EDIFACT and ANSI X12 are used when companies are sharing this information over an EDI network. The EAN.UCC Global Business Message Standard provides the most comprehensive coverage of the process, with a suite of eleven CPFR-specific XML message types.

**Table 12: Mapping Electronic Commerce Message Standards to CPFR**

| Message | EAN.UCC XML | UN/EDIFACT | ANSI ASC X12 EDI |
|---|---|---|---|
| Retail Event | Retail Event | N/A | Promotional Announcement (889) |
| Sales Forecast / Order Plan | Forecast / Forecast Response | DELFOR | Planning Schedule with Release Capability (830) |
| Exception | Exception Notification | N/A | N/A |
| Purchase Order | Purchase Order | ORDERS | Purchase Order (850) or Grocery Order (875) |
| Despatch Advice | Despatch Advice | DESADV | Advance Ship Notice (856) |
| Product Activity | Product Activity | SLSRPT | Product Activity (852) |
| Performance History | Performance History | N/A | N/A |

Source: Voluntary Interindustry Commerce Standards Association, (2004). CPFR: an overview. Retrieved October 20, 2005, from VICS web site http://www.cpfr.org

### 4.1.3 Information Shared in a B-2-B Supply Chain

A study reported in Geunes 2002 developed a simulation program to evaluate the value of information sharing in emerging supply chain initiatives such as CPFR in a realistic supply chain. This study based their results on the information that is shared in a Fortune-500 consumer products company supply chain that is made up of four echelons: the supplier, manufacturer, distribution centers, and retail outlets. The information that is shared in this supply chain is separated into four databases: Master, Sales, Status, and Performance and is shown in Table 13. The Master database includes product, supply chain infrastructure, transportation, and other cost information. The sales database is self explanatory, and status database handles the open orders, inventories, tracking sales vs. forecasts, and current plans. Customer service, inventories, transportation, costs, and financial measures are located in the performance database.

**Table 13: Information Shared in Geunes Study**

| Master Database | Sales Database | Performance Database | Status Database |
|---|---|---|---|
| **Products** | Total yearly sales | **Open Orders** | **Customer Service** |
| Price | Retail market size | Distribution centers | Fill rates for every DC |
| | | | Time through the supply chain |
| Weight | Seasonality by period | Plant | |
| Bill of Materials | Forecast errors | Warehouses | Total sales |
| **Supply Chain Infrastructure** | | Manufacturing Facility | **Inventories** |
| Names & locations of retail markets | | **Inventories** | Minimum |
| | | Finished Goods (DC, Warehouses) | |
| DCs | | | Maximum |
| Warehouses | | WIP (at plant) | Avg. levels at all facilities |
| Manufacturing Facilities | | Raw Materials( Plant) | Transportation |
| | | | Lead time statistics at every mode |
| Suppliers | | **Tracking Sales vs. Forecasts** | |
| Network Design Data | | **Current Plans** | **Costs** |
| Investment, Fixed, & Variable costs of operating the infrastructure | | Distribution requirements at DCs | Operation cost for every facility in the supply chain |
| | | Shipment plans at plant, warehouses, suppliers | Inventory cost at each facility |
| **Transportation Data** | | Production plan at plant | Freight costs at each link |
| Transport modes available | | | |
| Capacity (mean & standard deviation) | | | Administrative costs |
| Lead time (mean & standard deviation) | | | **Financial Measures** |
| Freight Cost for every feasible line | | | Profits |
| **Other Cost Data** | | | EVA |
| Inventory Holding costs | | | |
| Administrative costs (fixed, variable overhead) | | | |

Source: Geunes, J. et. Al. (2002). *Supply Chain Management: Models, Applications, and Research Directions.* Netherlands, Kluwer Academic Publishers.

To have a better understanding of the "As-Is" information model of the textile industry today, the Demand Activated Manufacturing Architecture (DAMA) project developed an information flow. Typically, a textile supply chain consists of several manufacturers, each representing a sector of the industry; i.e. fiber, textile, apparel (sewn

products) and retail ($TC^2$, 2000). A model of the industry was documented that shows the flow of information between these sectors and is represented in Figure 23. Information is passed between sectors in the form of Electronic Data Interchange (EDI) transactions, and typically each sector is customer focused (fiber focuses on the textile customer), rather than consumer focused (all sectors focus on consumer demand) ($TC^2$, 2000).

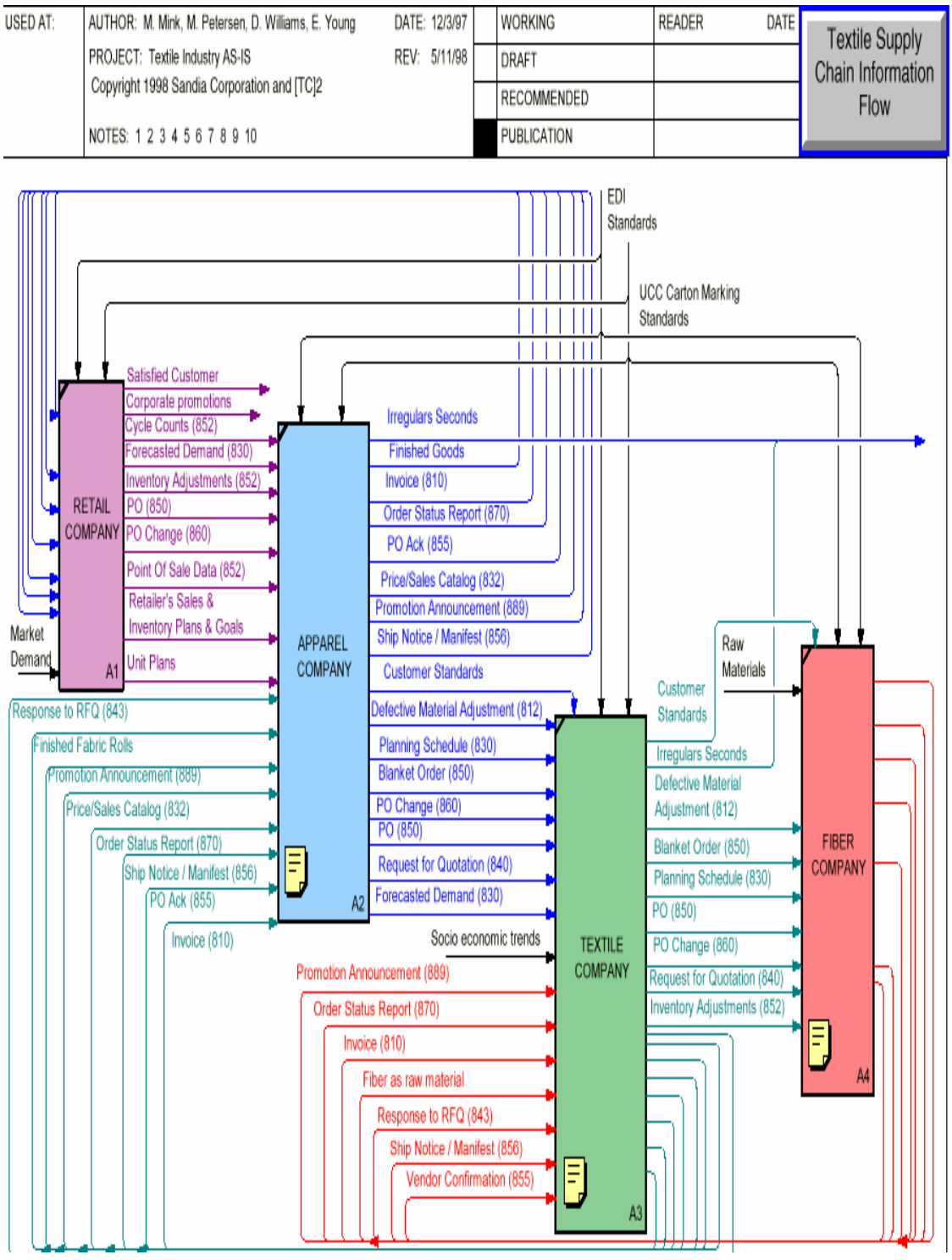


**Figure 23: AS-IS Model of U.S. Integrated Textile Complex**

Source: TC$^2$. (2000). DAMA model for collaboration. Retrieved October 20, 2005, from TC$^2$ website http://dama.tc2.com/

Based on the "As Is" model, the DAMA project was able to develop a collaboration model that a textile supply chain could follow to have an integrated information flow ( Figure 24). There are four possible collaborative activities that may be employed in this model: define products, forecast and plan capacity commitments, schedule product and product delivery, and expedite production and delivery exceptions ($TC^2$, 2000). This model assumes a collaborative supply chain, with multiple trading partners, working collaboratively to meet consumer demand. Trading partners must trust each other and technical data security must be implemented. Working together, the trading partners share information about their products, manufacturing capabilities, allocations of capacity to the partnership, and day-to-day operational status ($TC^2$, 2000).

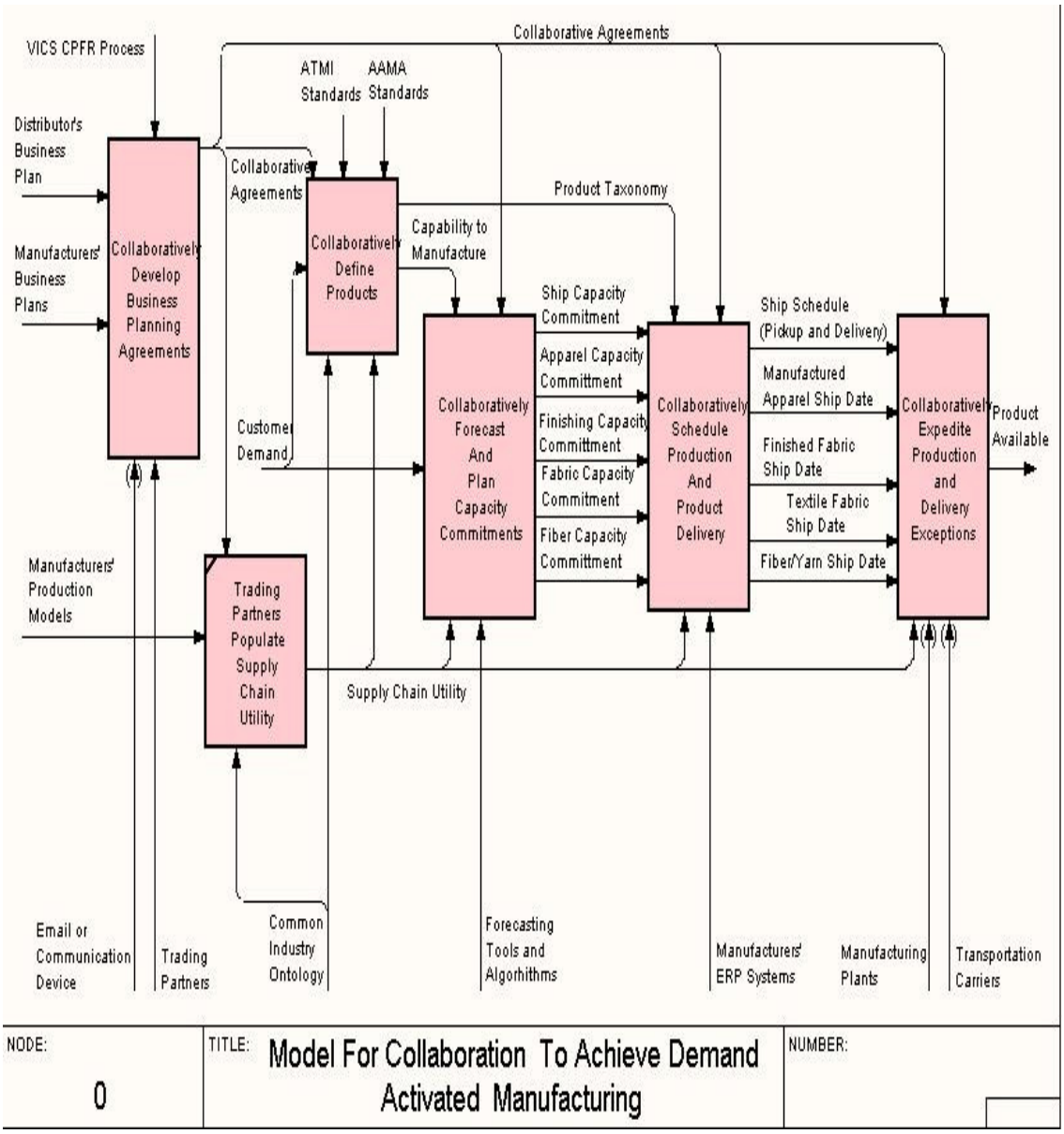


**Figure 24: DAMA Model for Supply Chain Collaboration**

Source: TC$^2$. (2000). DAMA model for collaboration. Retrieved October 20, 2005, from TC$^2$ website http://dama.tc2.com/

Unifi, a textured yarn manufacture located in Greensboro, North Carolina, has developed a website called Fyberserv that allows their customers to have visibility of critical supply chain information (Unifi, 2006). Fyberserv is capable of providing information to the customer about their order status, account history, product catalog, and ordering and

planning. These information categories are then broken down into more fields as seen in Table 14.

**Table 14: Unifi's Fyberserv Capabilities**

| **Order Status** | **Account History** | **Product Catalog** | **Ordering and Planning** |
|---|---|---|---|
| Scheduled Shipments | Shipment Listing | Customized Catalog | Unifi Catalog |
| Open P.O.'s | Shipments by PO | | Ordering |
| Shipments By Location | Shipments By Location | | Forecasting |
| | Items by Volume | | |
| | Invoice History | | |
| | P.O. History | | |

Source: Unifi. (2006). List of functions/data elements. Retrieved February 19, 2006, from Fyberserv website http://www.fyberserv.com/topsite/functions.asp

These models show what information the "as is" textile supply chain is sharing and what information a collaborated supply chain exchanges. Companies like Unifi are now promoting this collaborated capability as a way to differentiate their products and to attract new customers. For a company to collaborate it must have e-business technology already implemented in their business processes and also an establish relationship with their supply chain trading partners.

### 4.1.4 E-business Benefits and Barriers

A survey was conducted by Christy Cagle that focused on the understanding of how e-business can improve the competitiveness of the North Carolina textile mills. The top benefits found in her research dealt with improving their customer relationships and increasing the access to key business information. These results also show that the

company's business process improved by an increase in efficiency, improved internal communication, reduced cost, and delivery time to the customer.

Cagle's study results focus on the broad benefits from the use of e-business, and did not focus on in depth financial details. A Canadian study researched how adopting internet based solutions (IBS) improved certain financial ratios, such as revenues, cost of goods sold (COGS), and sales, general, and administrative expenses (SGA). This study's sample was made up of SME located in Canada, US, and Europe. The study results include SME in manufacturing, financial services, retail, internet service providers, and public service. Over 30% of the US SME reported an increase in revenues, 15% reported a decrease in COGS, almost 40% reported a decrease in SGA, and 25% would not attribute any financial benefits to the adoption of internet based solutions.

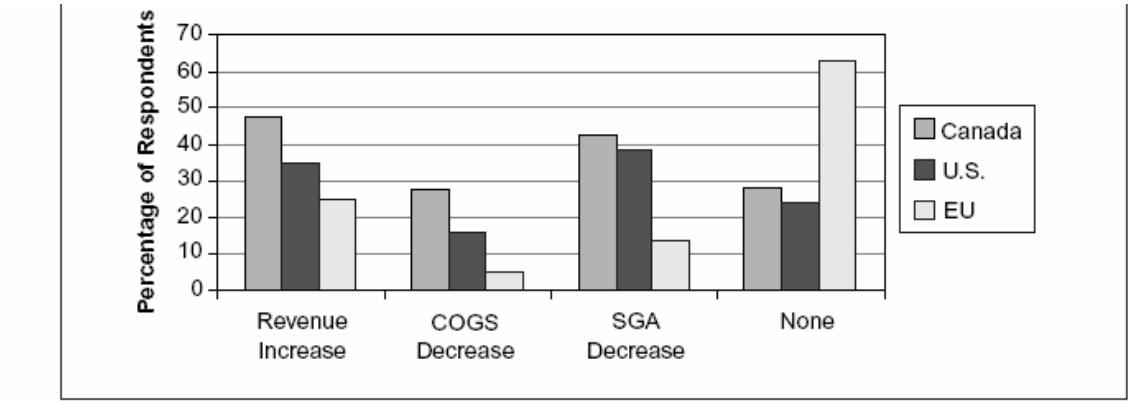


**Figure 25: Financial Benefits Attributed to E-business Adoption by SME**
Source: Canadian E-business Initiative. (2003). Net impact study the international experience. Retrieved December 15, 2003, from Canadian E-business Initiative website http://www.cebi.ca/Public/Team1/Docs/netimpact_report.pdf

The results from Cagle and the Canadian study focused on the benefits manufacturers generate when using e-business in all business processes. In contrast the DAMA project, CPFR, and Lee and Whang (discussed in Chapter 2) focus on what benefits are caused by implementing supply chain e-business initiatives.

The results from the DAMA simulation models proved that the e-business collaborated architecture (CISS) did, in fact have a positive impact on order lead-time and inventory among the trading partners for cotton slacks when compared to the traditional supply chain model (TISS). The two lead times that were calculated for each partner were the planning/production lead-time and the order lead-time. The planning/production lead-time is defined as the time when a forecast enters Demand Planning until a completed production order is sent to the Finished Goods Warehouse. The order lead-time is defined as the time from order receipt until it is delivered to customers. Model results are shown below and illustrated in Figure 26 and 27.

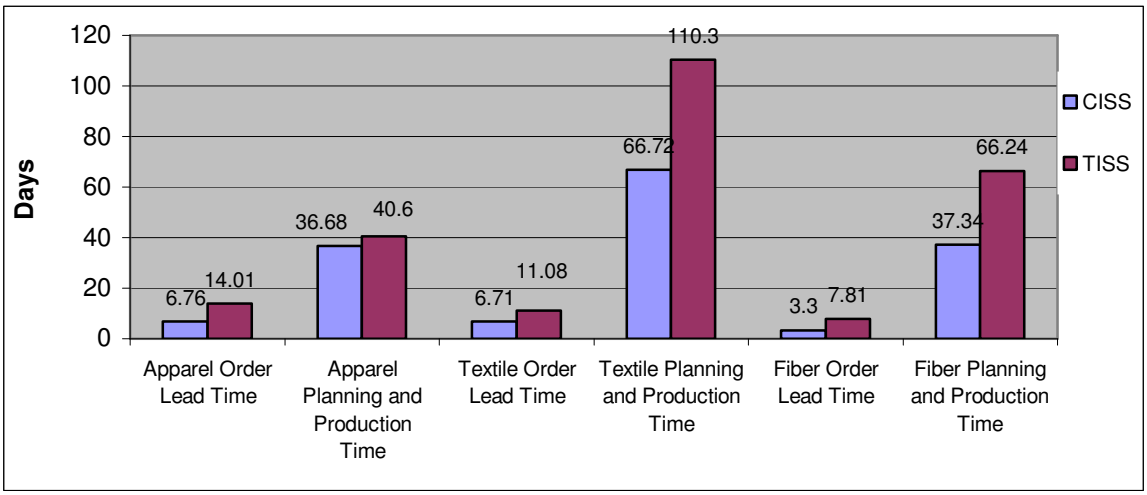


**Figure 26: Lead Time Model Summary**

**Source:** TC$^2$.(2001B). DAMA Final Report. Retrieved October 20, 2005, from TC$^2$ website http://www.techexchange.com/thelibrary/Dama/Dama_Final.html

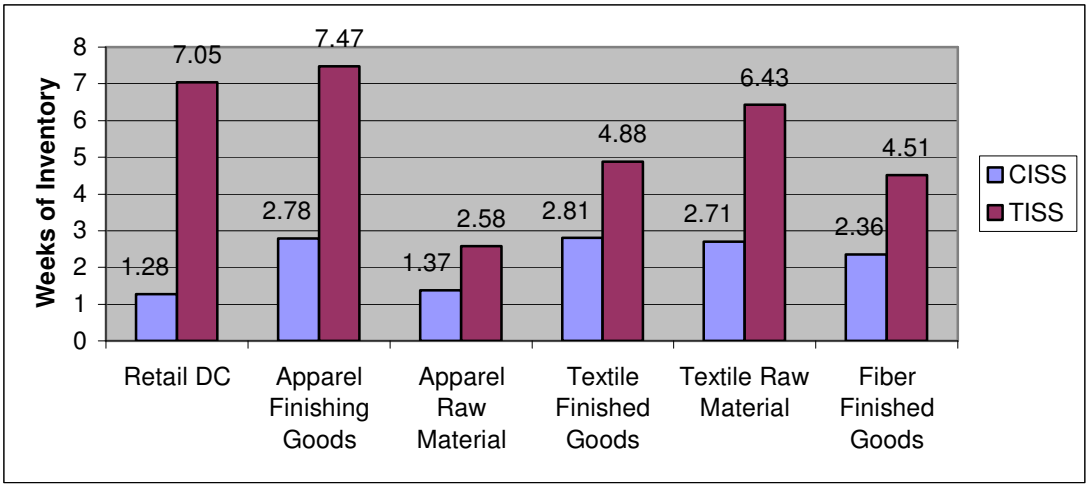


**Figure 27: Inventory Model Summary Results**
Source: TC$^2$.(2001B). DAMA Final Report. Retrieved October 20, 2005, from TC$^2$ website
http://www.techexchange.com/thelibrary/Dama/Dama_Final.html

• "Across all partners in the collaborative supply chain model (CISS), there was a reduction of 16 days in the order lead-time versus the traditional supply chain model (TISS), which is a 49% decrease. Also, the collaborative model reduced 137 days from the planning / production cycle which represents a 49% decrease in time in the supply chain." **Source: TC2, 2001B**

• "For each partner, in the collaborative model (CISS), there was a reduction in finished goods inventory from just over 6 weeks worth of units to approximately 2.5 weeks of inventory while providing the same level of customer service." **Source: TC2, 2001B**

A report on CPFR by Global Commerce Initiative (GCI) researched what the B-2-B savings were in the apparel industry. The study analysis shown that B2B solutions present a $34 billion potential savings opportunity in the apparel industry, 24 percent ($8.3 billion) of which can be captured by utilizing Collaborative Planning, Forecasting, and Replenishment CPFR (GCI, 2002). The results of this analysis can be seen in Figure 28.

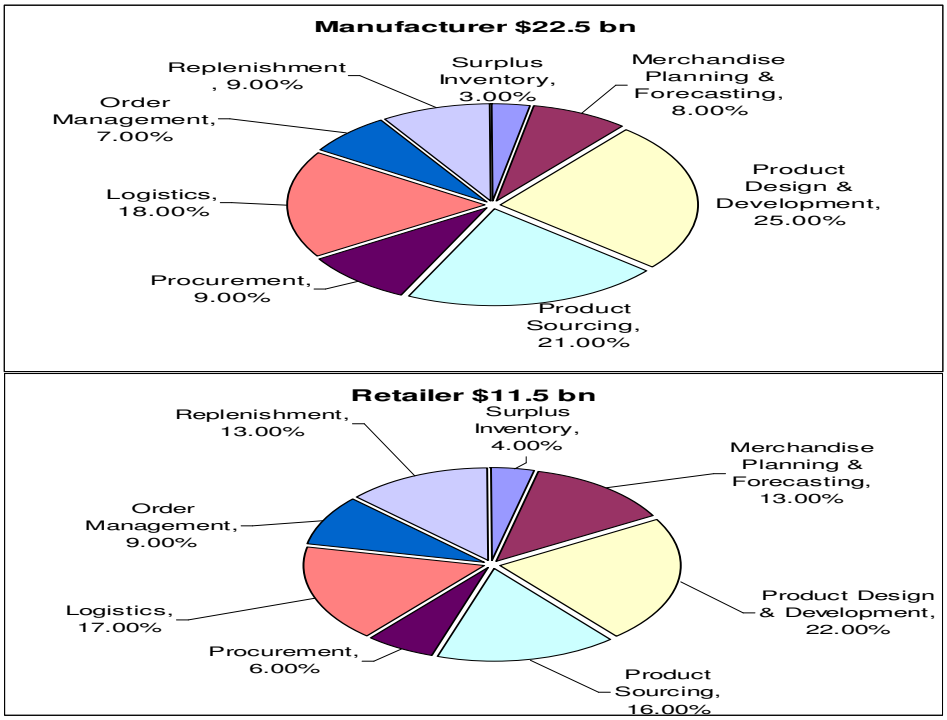


**Figure 28: B-2-B E-Business Savings for the Apparel Industry**
Source: GCI. (2002). Global commerce initiatives guidelines CPFR. Retrieved January 15, 2006, from GCI website www.vics.org/committees/cpfr/ voluntary_v2/CPFR_Tabs_061802.pdf

Lee and Whang analyzed results from a survey study by Stanford University and Andersen Consulting that looked at 100 manufacturers and retailers (Lee, 2001). These companies were involved in the food and consumer products supply chain. As Figure 29 illustrates, companies that reported higher than average profits were the ones who were engaged in higher levels of integration (Lee, 2001).

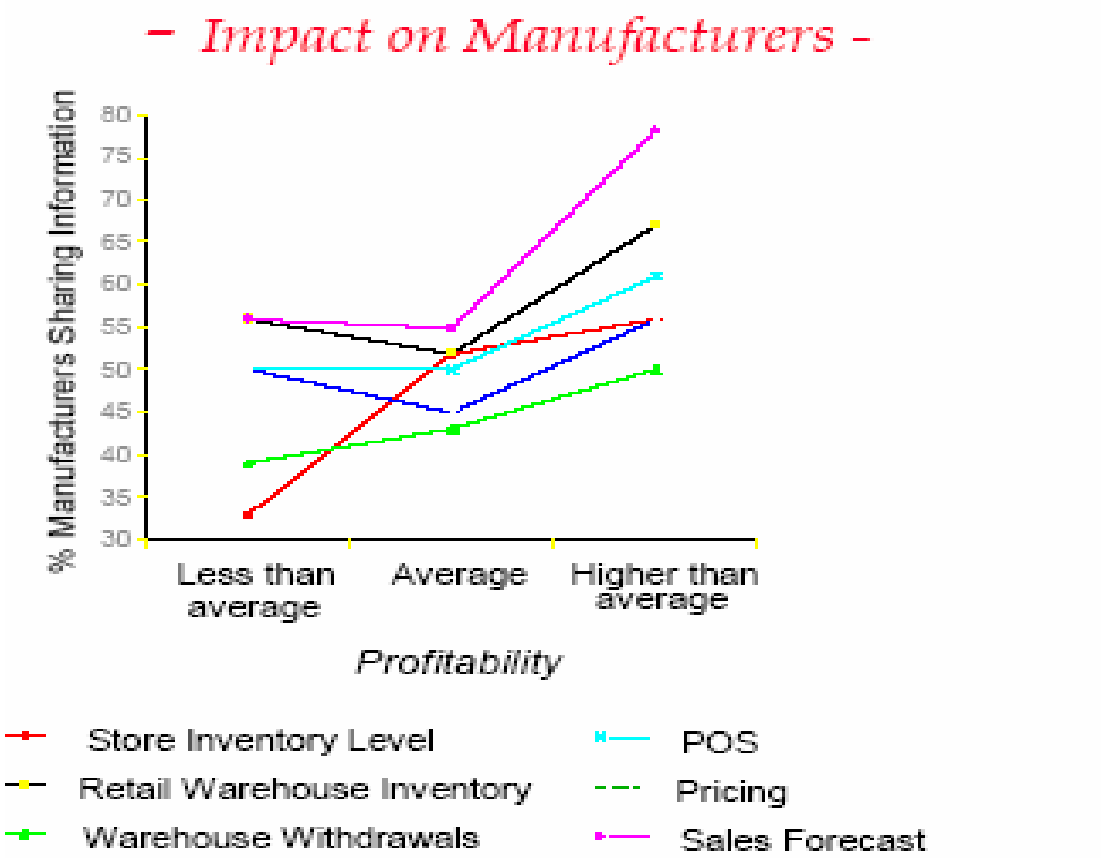


**Figure 29: Higher Profits Linked with Higher Level of B-2-B information Sharing**
Source: Lee, H.L. & Whang, S. (2001). E-business and supply chain integration. *Stanford University Global Supply Chain Management Forum.*

Based on the results of these studies, B-2-B e-business initiatives can generate many benefits for a company when implemented in their business and supply chain processes. Implementing this technology into a company's process is not that straightforward due to the many barriers they will have to face. Figure 30 contains compiled barrier results of four e-business studies: [Cagle], [Canadian E-business Initiative], [Meier], and [Industry Directions]. Again Cagle's study focused on NC textile mills, the Canadian and Meier focused on international SME, and the Industry Directions sample was made up of companies from the US consumer goods supply chain.

The results in Figure 30 illustrates that only one barrier was in the top ten for all four studies, cost. Lack of skilled staff and proven business benefits were the only two common

barriers that were in at least three of the studies. The remaining 18 barrier classifications were in two or fewer of these studies. Based on these results companies in all industries are not implementing e-business supply chain initiatives due to the high initial cost of the project. Also, the lack of proven business benefits has highlighted this high initial cost.

| Barrier Rank in Study | Cagle (NC Textile Manfacturer) | Canada (SME) | Meier (Swedish SME) | Syncra Systems (US Consumer Good Industry) |
|---|---|---|---|---|
| 1 | Security issues | Cost | Lack of Human Resources | Internal Changes to Difficult |
| 2 | Lack of skilled staff | Time constraints | Lack of share technical standards | Cost |
| 3 | Time constraints | Lack of proven business | Immature software | Data protection |
| 4 | Readiness of business partners | Worker Training | Lack of skilled staff | Lack of business benefits |
| 5 | Data protection or privacy issues | Lack of upper mgmt. support | ness of Business Partners | No budget for software |
| 6 | Lack of proven business benefits | Lack of skill staff | Security issues | Lack of upper mgmt. support |
| 7 | Cost | Bad experience in the past | System not suitable for E-business | Do not want to share information |
| 8 | Lack of shared technical standards | Regulatory barriers | Cost | |
| 9 | Lack of direct customer contact | | Lack of direct customer contact | |
| 10 | Cataloging and classification issues | | Change management | |

**Figure 30: E-business Barriers**

**Sources: Cagle, 2006, Canadian E-business Initiative, 2003, Meier, 2001, and Industry Directions, 2000**

There are other barriers that are more specific to the textile manufacturing industry. These results were found in European Commission, 2004, and are stated below

- "The average micro/small size of the vast majority of the operators and the very limited degree of computerization"
- "The textile and clothing industry is characterized by a very conservative culture. Despite a tradition of long-term partnerships, many of its members are reluctant to pass on information and to open up communication process"
- "A broad group of firms is rather cautious and is implementing stand-alone ICT solutions. The laggard firms – many of them micro-enterprises – continue to rely on traditional methods even when they move towards closer co-operation with their partners"
- "Diversity of Information Systems (as for typology and architecture) and diverse quality of access to ICT which may inhibit the process of integration"

### 4.1.5 E-business Justification

The process companies follow to justify an implementation for an e-business supply chain project is relatively hard to find in published resources. This problem is created from the fact that e-business investments are even more complex to evaluate than traditional IT investments due to the inter-organizational nature of e-business (Lesjak, 2005). The problem is particularly demanding because the proper assessment of e-business projects should include- besides standard economic theory approach- also the feature of traditional IT projects as well as the features related to the specific nature of e-business (Lucas, 1999).

The influence of e-business on profits and costs has been studied by the Brookings Institution along with the Momentum Research Group (Optimize Magazine, 2002). Their research has been carried out on a representative sample of companies from the Dun & Bradstreet database, including 2,065 in the US and 634 companies from France, Germany, and Great Britain. The results include more than 63 percent of investigated enterprises have no formal procedure for the assessment of the impact of IT investments.

Another study conducted by IDC in 2000 in more than 650 companies accomplished the projects of introducing e-business. Only 33 percent of companies used any of the existing return on investment (ROI) analysis, 16 percent of surveyed companies did not know if the analysis had been carried out, and 51 percent of companies did not use any of the traditional ROI analysis (Cummings, 2001).

Lesjak and Vehovar performed a study to understand what formal evaluation methods were followed when an e-business project over $4,000 was implemented. Their sample was made up of 335 Slovenian companies that have recently implemented this type of e-business project. Study results illustrate that 66.6% of the companies did not use any methods, and

they have also not even though about evaluating their e-business projects. While roughly 21% of the companies are using or planning to use a formal method of evaluation, and the remaining 12.4% are thinking about using a formal method.

Lesjak's study had three major formal methods that were used by these companies, which are Return on Investment (ROI), Cost Benefit Analysis (CBA), and Net Present Value (NPV) (Lesjak, 2005). Out of these three methods ROI and CBA are the most frequent formal methods, while NPV is used in one-third of these companies (Lesjak, 2005).

Based on this Phase 1 research, an open ended interview instrument was developed. This instrument was used to collect the data to complete the analysis. The primary data collected during these interviews will be discussed in further detail in this research. The open ended interview instrument used to collect this data is shown in Appendix A.

## 4.2 Phase II: Analysis of Primary Data

Phase II is split into two sections. The first section contains the data collected with the open ended interview instrument. The second section contains cases studies that were conducted with US textile manufacturers.

### 4.2.1 Open Ended Interviews

The sample contained ten companies with 25 total respondents. Of those responding 12 interviews were conducted and details about the interviewees are shown in Table 15. The company size listed in Table 15 was based on the opinions of the respondents. There were two more interviews than companies because one company had multiple divisions that were in the sample. The interviews were conducted from November, 2005 through February, 2006.

All of the interviews were conducted in person except for one that was conducted via telephone. The data was collected by traveling throughout the Southeastern United States to interview the manufacturing companies in the sample.

**Table 15: Interview Sample**

| Interview # | Company Category | Company Size |
|---|---|---|
| 1 | Spun Yarn Manufacturer | Small |
| 2 | Spun Yarn Manufacturer | Large |
| 3 | Fabric Manufacturer | Medium |
| 4 | Spun Yarn Manufacturer | Large |
| 5 | Denim Manufacturer | Small |
| 6 | Air-Jet Yarn Manufacturer | Small |
| 7 | Vertical Upholstery Manufacturer | Small |
| 8 | Niche Knit Fabrics | Small |
| 9, 10, 11 | Vertical Textile Manufacturer | Large |
| 12 | Vertical Textile Manufacturer | Large |

The 25 executive respondents participated with the research team in the form of in-depth interviews containing open ended questions. Within the sample respondents, two were CEO, four were Director of Supply Chain Activities, one was the President of Manufacturing, four were President of Sales, two were IS Directors, and four were Vice Presidents of Manufacturing within their respective firms. The strong sample, along with the experienced respondents, ensured highly credible information to analyze in Phase II of the study.

## Interview #1

Company 1 is a small spun yarn manufacturer that has the ability to produce a wide range of open end spun yarns. This company has been in business for over 60 years, and now is targeting many end use markets.

Company 1 is exchanging a small amount of information with their suppliers and customers. They exchange forecast information with their suppliers and customers. Their main customers ask for specific product's inventory once a week. This information is not exchanged on a set schedule because they only share information if their supply chain partners ask.

This company is not using any type of EDI or e-business tools to communicate with their supply chain. The company is exchanging information through the use of fax, email, and phone. The primary reason why Company 1 does not use e-business technology to handle their B-2-B supply chain transactions is because there is no demand for it. None of their customers or suppliers has asked them to exchange information electronically. Also, they do not see any cost savings from implementing this technology into their business processes.

Company 1 did mention they would implement e-business in their supply chain if a customer would request it. The perceived benefits they felt would be created from the use of this technology are that it would reduce transaction cost because of the reduction of paperwork. Also the customer would perceive them as a company that is innovative in supply chain technology. This company also felt that this technology would be used by businesses that are closer to the customer.

## Interview #2

Company 2 is a large spun yarn manufacturer that has open end and air jet spinning capabilities. They have multiple target markets such as t-shirt, fleece, and hosiery products. Company 2 sells their products to the CAFTA region and to domestic customers.

The customer sophistication decides what type of information is exchanged with Company 2 electronically. The larger customers that are in a retail supply chain require more information to be exchange electronically. For niche market items, Company 2 will allow those customers to have more access to their information, so they will not over produce or have high inventory levels. However Company 2 will not allow customers of commodity products to have open access to their product's supply chain information. If Company 2 allowed this, the customers would want inventory that is already allocated to other customers to fulfill their orders. Company 2 has a production and forecast meeting on a rolling 12 week schedule with their large customers to discuss supply chain information. Company 2 receives HVI data for each cotton bale in advance before the bale is received at their locations.

They are exchanging this information with their large customers by VAN EDI and they are able to handle both ANSI X12 and EDIFACT standards. The cotton bale information sent by their suppliers is also by VAN EDI or the QRNET 32 service provided by Cotton Inc. EFS. Company 2 utilizes email, phone, and faxes with their smaller customers and suppliers. The reason why Company 2 implemented EDI was based on customer requests. The majority of their customers that are in a retail supply chain make this a requirement to do business with them.

Company 2 has the information that is exchanged with their suppliers integrated in their ERP system. This information is then put into the EFS to manage their polyester and

cotton inventory. The EFS system has allowed them to have certain bales direct shipped to the production facility on bale laydown basis. This system also allows them to manage orders and to perform production planning. The information exchanged with their customers is being used to track shipments per contract and inventory management.

Company 2's planning department is more efficient through the use of EDI because it has allowed key decision makers to have visibility of certain information. This technology has also made the information more accurate due to the elimination of data entry errors and reduced the amount of time per transaction. There was also cost savings from implementation of this technology because it reduced the transaction cost by eliminating the overhead costs with automation.

The barriers that Company 2 has to face are their supply chain partners do not have the resources to implement e-business technology. The smaller customers and suppliers do not have the financial or the staff resources to implement this technology. Company 2 does not want to totally integrate their system with their supply chain partners because they feel their supply chain costs will increase. This increase would occur due to their partners systems' errors.

## Interview #3

Company 3 is a medium sized fabric manufacturer that has been in business for over 70 years. They have the capabilities to produce from yarn to fabric. These products are targeted to industrial, military, apparel, and many other markets.

Company 3 exchanges supply chain information with both their suppliers and customers electronically. With their suppliers they, receive information about their shipment for their raw material which is fiber or packages of yarn. The information contains the number of containers, weight of the material, purchase order #, vendor ID, ship date, and arrival date. Company 3 also receives fiber quality and inventory information from the cotton merchants electronically. They can also view 13 weeks of a dyed yarn supplier's production schedule electronically by extranet technology. They do not receive any information from their customers, but Company 3 does send shipment information to them electronically. The information includes the number of rolls, yards per roll, fabric characteristic information, invoice #, ship date, and arrival date.

This information is exchanged with their customers and suppliers through the use of a VAN EDI system. This system translation and mapping software is based on ANSI X12 standards. All of this shipment information is on an EDI advance shipment notice (ASN) or an 856 transaction. The cotton quality information is integrated with their internal system with Cotton Inc. EFS. One of their supplier's production scheduling information is made available by web interface or middleware software. Any supplier of theirs that does not have EDI is looked at in a negative perspective because they are making Company 3 add more cost to their product. Company 3 was one of the first textile manufacturers to implement

EDI. The reason why they were ahead of the technology curve is because they felt it gave them a competitive advantage.

The information that is received by Company 3 over EDI is used for inventory management. The information is integrated into their ERP system so once it is sent the information is mapped to the correct tables. The increase visibility of inventory information and weekly shipments per customer help manage inventory for their customers. Also the data has allowed their customers to track roll information back to Company 3's slasher set information. The EFS is used to track cotton inventory based on HVI information. The EFS system also allows Company 3 to have selected bales to be shipped based on what type laydown is going to be needed that week.

EDI has eliminated data entry overhead in transaction cost from the integration of this information into their systems. This has increased the accuracy of the information by reducing data entry errors and increased the visibility of inventory information. The increase visibility has allowed them to reduce inventory and has allowed tracking shipments in a better manner for customers. Having the ability see this information has reduced time spent on non value added tasks. The EFS system has reduced lab testing costs by the reduction of HVI tests.

Not all of Company 3's suppliers and customers have the capability to use EDI. The barrier they have faced in the past is smaller supply chain partners could not afford the cost per month. Also, they did not have the IT infrastructure and staff to support EDI.

## Interview #4

Company 4 is a large spun yarn manufacturer that has been in business for over 50 years. They have the capabilities to produce air jet, open end, and ring spun yarns. The markets they target are knitting, weaving, and hosiery.

In their supply chain, there is not a large amount of information being shared between trading partners. They do have the capability to exchange information with both customers and suppliers electronically. In their supply chain, they feel that since they are dealing with a small number of large transactions, there is no reason to share much information. They do receive and send shipment information, purchase orders, and invoices electronically. Company 4 can also make inventory for specific products visible to their customer over the internet. Their suppliers also send the cotton bale inventory and quality information to them.

Company 4 has many capabilities to send and receive information electronically. First, they receive and send shipment information, purchase orders, and invoices over a VAN or web based EDI. They use an e-business module to display inventory information on the internet for their customers. For the suppliers, they send HVI data to Company 4's FTP site, and then they use Cotton Inc. EFS to schedule the laydowns. The EDI system was implemented due to customer requests and the e-business module was implemented for increasing their flexibility.

The information coming in from the suppliers is being used to categorize bales and schedule laydowns at the plants based on HVI data. This laydown information is then put into their internal systems by the EFS system to track laydown performance. The shipment information is being used to update and manage the raw material and finished goods

inventory levels. Company 4 also integrated the electronic purchase orders and invoices to help manage orders.

The implementation of e-business technology has reduced overhead from transaction costs. This elimination has increased the data accuracy and decreased the amount of time spent on non value added tasks. E-business technology has allowed Company 4 to reduce the amount of shipments and inventory held at their warehouse and increased direct shipments to the plants. The direct shipments has reduced bale inventory and transportation costs. Using the EFS system has reduced raw material cost because of their data tracking capabilities.

The major barrier Company 4 faced when implementing this technology into their supply chain is there is no demand for e-business. They feel customers do not use e-business technology because they can order all the yarn they want through email.

## Interview #5

Company 5 is a specialty denim manufacturer that has both local and global manufacturing. They are a vertical denim manufacturer with yarn producing, warping, warp dyeing, slashing, air jet weaving, and fabric finishing capabilities. Markets they target are denim designers and apparel manufacturers.

Company 5 does not have to share information with the majority of their supply chain partners. They have exchanged SKU inventory information with two of their largest customers. Company 5 has recently implemented a Vendor Management Inventory strategy with an international customer. They are responsible for updating their customer's system with their finished goods inventory.

In order to exchange inventory information with two of their larger customers, they used a 3rd party EDI service. This service is different than a VAN because Company 5 does not have to develop a mailbox or translation or mapping software. All Company 5 has to do is email the database information in their own format and the 3rd party will convert this file into an EDI transaction and send it to their customers VAN. For Company 5 to perform VMI, they were allowed access to their customer's system by an extranet. They implemented these different e-business technologies based on customer requests.

The information they exchange over the 3rd party EDI service is being used by their customers for production planning and order management. As for any in-house business processes, they do use any of this information. All of the information being shared is only being used by their customers.

Company 5 was of the opinion using e-business has increased the speed of doing business. Almost all information can be available to any trading partner at all times if

requested. There is also increased customer satisfaction since they can be integrated into their business processes. The integration between Company 5 and their supply chain partners has also improved their data accuracy.

A barrier that Company 5 faced when implementing e-business into their processes was the cost. Their customers wanted them to invest a large amount of money into old systems since their customer's use legacy systems. Also, they did not have enough trained personnel to handle its implementation. These are reasons why they used a 3rd party service to perform their EDI transactions.

## Interview #6

Company 6 is a small air-jet spinning manufacturer. They are a small niche yarn manufacturer and their business is mainly from synthetic yarns. They target specialized performance fabrics.

Company 6 is open to the idea of exchanging supply chain information with their partners, but they are too small for the partners to share this information. Most of the time the information provided to them from their customers is inaccurate. However they said their most successful relationships are with customers that exchange production information and inventory levels.

None of this information is being exchanged electronically. It is exchanged mainly by telephone and paper. Some of the information is sent by email but there are no e-business technologies implemented into their business processes. Since there is no integration in their supply chain, there is no use for exchanging information.

The size of their company is the main barrier they face when implementing this technology. They are too small and customers are not requesting it since they do such a small amount of business with them. Company 6 is buying so little from their supplier and they have so much supplier turnover that there is no reason for them to integrate their systems. The cost of the systems is too high, and they do not have the staff to manage the system.

## Interview #7

Company 7 is a vertical upholstery manufacturer that has been in business for over 50 years. Their process starts with extruding Olefin fibers into its own taslan, chenille, and boucle yarns. They have Dornier jacquard weaving machines, and this fabric can be finished on tenter frames, printing machine, needle punched, or be softened by a Biancalani tumbling machine.

Electronically they receive purchase orders from their customers. They have the capabilities to send invoices and shipment information to their customers. These customers are large furniture manufacturers, and only five to six customers want their products to have barcodes.

They use a VAN EDI system to receive and send this information. However this information is not mapped into their system. Instead, it is mapped to be printed out on a fax machine. This information is then entered into their system manually. They implemented this technology based on a customer request. Company 7 only uses the purchase order information to schedule the amount of raw material that is needed to produce the products. This EDI system is an integrated fax machine. There are no benefits that were generated through the use of EDI.

The main barriers Company 7 faced when implementing the EDI system is the time needed for the project and the project's cost. Company 7 was of the opinion that EDI was not reliable. This opinion was based on the fact that in the past they lost transactions over a VAN. So they started emailing transactions just to make sure the customers received them. The textile upholstery supply chain does not have a high level of trust to share specific information, and it does not have enough standardization.

## Interview #8

Company 8 started out as an apparel knit manufacturer but now has changed their business model to focus on niche markets. Their main target market is healthcare, and then the remainder of their business is industrial fabrics, government contracts, and apparel.

In their supply chain, they do not have any e-business technology being used to integrate their trading partners. The main information they exchange is product specifications, and they provide a certification for raw materials being used in the government supply chain. Email is the main source of communication with their trading partners. They also use fax and telephones. Company 8 would implement e-business technology into their business processes if a customer requested it.

The main barrier Company 8 faces when implementing e-business technology is the cost. They do not have the financial resources or the IT staff to handle an e-business system. Also they face too much turnover with customers and suppliers to establish a relationship to benefit from using e-business.

## Interview #9

Company 9 is large vertical textile manufacturer that has been in business for over 50 years. They have yarn manufacturing capabilities, different fabric formation technologies, and finishing and dyeing machines. This company targets medical, apparel, and many other markets.

Sharing information electronically is very important for this company. They receive information from their suppliers and customers and send information to their customers. The information they receive from their suppliers is shipment notifications, invoices, purchase order acknowledgements, and shipment manifest. What they send to their customers is purchase acknowledgments, invoices, shipment notifications, and inventory listings. The customer sends them purchase orders, shipping schedule, text messages, and purchase orders with release capabilities.

All of this information can be exchanged by EDI. Some of the information can also be exchanged by file sharing and a customer self service website. Their EDI system can use both the ANSI X12 and EDIFACT standards. The file sharing capabilities is basically an extranet operation. Company 9 sets up a password for a customer to gain access to a secure site to download information and import this into their system. The customer is notified by an email every time there is new information available to be downloaded. The customer self service website is a web interface that is tied into Company 9's system. This capability allows the customer to have access to a certain website and for them download the information as an excel file. They also looked at implementing XML, but there was no demand for this product. One factor for implementing these technologies was mainly due to customer pressure. Other factors include data accuracy and cost reductions.

All of the shipment transactions such as shipment notices, manifests, and schedules are being used by Company 9 and their customers to manage inventory levels. The purchase orders and invoices are being used for order planning. Inventory listing transactions are being used to mark items on hold for certain customers in their systems and then automatically sends a list of inventory items on hold for the customer. The text messages are used when there is a change in information such as a decline in a purchase orders. There is also a purchase order with release capability. This information is used to send customers a forecast of production and a shipping schedule. All of this information is set up in a batch process except for the purchase order acknowledgement that is in real time.

The benefit generated from implementing e-business technology is there were time reductions. A time reduction was found in the payment cycle and the order cycle. The reason for the time reduction was the elimination of manual activities. They have also seen a reduction in receiving trucks or transportation cost. On the other hand, they had to face many barriers during its implementation. For example, smaller suppliers do not have the IT staff to handle a project like this. Also, the cost is too high for implementing e-business capabilities.

## Interview #10

Company 10 is the same company that was interviewed in 9, but the interviewee is in a different division.

In this division, they only share product status information, inventory, and shipment notices. The majority of domestic customers want this information sent electronically, but only one international user has requested the use of e-business technology.

This division is pushing the use of file sharing with their customers. However, they still do use VAN EDI with some of their customers, and it is based on how the customer's business processes are setup. This technology was implemented in this division based on customer's request. They do not use this information internally, but their customers do. The customers use it for planning their production based on the inventory and shipment information.

Implementing e-business allowed Company 10 to generate many benefits. For example they were able to reduce the cost per transaction by eliminating manual tasks. This also increased the information accuracy and customer satisfaction. Company 10 did not know of any barriers to the implementation of e-business.

## Interview #11

Company 11 is the same company that was interviewed in 9 and 10, but the interviewee is in a different division.

In this division, they share more information than Company 10 did electronically. They do not receive any information from their customers. They only sent information to them. Invoice, shipment notice, and purchase order acknowledgement is the information that is requested to be shared in this supply chain. The majority of the information sent out of these three transactions is shipment notices. Smaller customers in this supply chain are not using e-business with Company 11. However, the larger customers are using e-business with both their customers and suppliers to have a totally integrated supply chain.

Company 11 has implemented VAN EDI and file sharing technology to share this information with their customers. Over 90% of volume is conducted electronically, and while the remaining customers want this information is it shared by email and faxes. The shipment notice information is being used to monitor finished goods inventory per contract. The customers that are exporting these goods to another country are using the shipment notice information for freight tax reasons. A request from customers is why e-business technology was implemented to share this information in this supply chain.

Implementing e-business allowed Company 11 to generate many benefits. For example, they were able to reduce the cost per transaction by eliminating manual tasks. This also increased the information accuracy by eliminating error reductions. The only barrier that Company 11 felt was that smaller customers did not have the financial resources or IT staff to handle this type of project.

## Interview #12

Company 12 is a large textile manufacturer that focuses on fabric formation and finishing processes. They have been in business for over 50 years now. The company has two divisions, and they target the upholstery, automotive, and industrial markets.

In their supply chain, they have the ability to receive and to send information electronically to suppliers and customers. Company 12 receives shipment notice information from their raw material suppliers and has implemented this with their top five suppliers. This document contains the vendor number, purchase order, raw material characteristics, weight, and the number of packages. With their customers they send shipment notices that contain the same information as what their vendors send them. They also have the ability to send invoice and a sales order acknowledgement. Company 12 also sends order history information over the internet to their customers.

In order to send and to receive their shipment notice information, Company 12 has set up a customized EDI system. This system is different than the other companies' systems because it does not use a VAN or a 3rd party to exchange information. All of the information sent to the customers is exchanged by a FTP process. For the order history to be available to their customers, Company 12 has developed a web interface, but most customers still use the phone to exchange this information. All of this information is updated in batch process every 15 minutes. Company 12 implemented e-business technology to exchange information in their supply chain based on customer requests.

The shipment information received by Company 12 is used to track the amount of yarn received against a contract. This information also updates their raw material inventory after the information is mapped into their internal system. On the other hand, the shipment

notice information they send to their customers is used to update their finished goods inventory. Company 12 can see what fabric has been shipped against their sales orders and can determine how the rest of inventory is allocated. The sales order, invoice, and order history information is being used to communicate to customers in a standard process.

Implementing e-business allowed Company 12 to generate many benefits. For example, they were able to reduce the cost per transaction by eliminating manual tasks. This also increased the information accuracy by eliminating error reductions and decreased the amount of time spent on non value added tasks. Allowing their customers visibility of their order history has allowed them to increase their customer satisfaction levels. Even though e-business has generated these benefits for this company, they still had to face barriers such as VAN EDI system that was not dependable. When implementing this technology into their business processes, Company 12 had to face user resistance to the new system from their employees.

## Vendor Interview # 1

Based on the interview results it was found that four companies were using Cotton Inc. EFS system. Since this is such a common e-business tool used by US textile manufacturers an interview was set up to discuss this system in more detail.

In the 1960's, High Volume Instrument (HVI) line was created to measure the key properties yarn mills used to determine the quality of cotton they were buying. The EFS® (Engineered Fiber Selection® System) MILLNet program was developed by Cotton Incorporated to handle cotton HVI data and provide information on how to properly select cotton mixes (Schild, 2003). The MILLNet system also provides information to the mill concerning the variance present in the mill's inventory for each HVI property (Schild, 2003). Mills use this information to select superior cotton mixes that perform as expected on high-speed automated equipment (Schild, 2003).

The EFS® has two versions MILLNet32™ or MILLNet DOS version. MILLNet 32™ has more data storage capacity when compared to the DOS version based on its addition of the SQL server 2000. The MILLNet 32 system also has contract management capabilities which the DOS version does not have. These are the main differences between these two systems. Both of these systems can approve, categorize bales and select laydowns through access of HVI data. HVI Data can be passed between trading partner's MILLNet through QRNet32 which supports ANSI X12 data transfer (Cotton Incorporated, 2006). QRNet32 uses standardized EDI file formats shared by businesses representing all sizes and types of users in the textile industry (Cotton Incorporated, 2006). How this information is exchanged between trading partners through the EFS system is described below.

## QRNet32 Work Flow

**ONE**
"Once a contract is finalized, the cotton merchant sends the mill an EDI file such as an 863 Sample Tag List (STL) containing High Volume Instrument (HVI) test results.
After receiving the STL, the mill imports that EDI data into QRNet32 and exports it to MILLNet for review. If the mill requests third party HVI test results from another HVI testing facility, an 863 Test Result (TR) travels between those parties through an electronic mailbox."

**TWO**
"The mill then sends the merchant an 863 Sample Approval/reject List (SARL) indicating which bales it accepts or rejects."

**THREE**
"The merchant responds with an 856 Advance Tag List (ATL) containing the bale weights and shipping information for a particular load of cotton. After bales are loaded, the merchant sends the mill an 856 Loading Notice (LN) showing the actual shipping data such as contract information, HVI data, cost data, bale numbers, shipping and arrival dates, etc."
**Source: Cotton Inc. B, 2006**

### 4.2.2 Case Studies

This section contains three case studies that focus on the implementation of e-business into an US textile manufacturer's supply chain when dealing with B-2-B transactions. The first case study focused on what is the cost difference for a greige fabric manufacturer to send or receive an advance shipment notice manually, through a VAN EDI system, or AS2 software. The second case study focused on why a large spun yarn manufacturer's customers are starting to inquire about having information made visible on the internet and also what benefits does this create for their supply chain. The Third case study documented how a fabric manufacturer customized a process to eliminate VAN charges when exchanging B-2-B supply chain information.

## Case Study 1

### Problem Description

Company A is a mid-sized greige manufacturer located in the southeastern United States. This company has the capability from manufacturing yarn to making fabric for different target markets. The company is focused on being fast to respond to their customer's needs, having high quality, and to create flexibility in the use of their technology. In order to accomplish these goals and to reduce cost, Company A has been early adopters of certain e-business technologies in their supply chain.

To reduce cost and to become more flexible in communicating with their suppliers and customers, Company A in 1991 developed an in house system to handle electronic data interchange (EDI) transactions over a value added network (VAN). Company A is now interested in finding out if their VAN costs could be reduced with adopting a new version of EDI that is communicated over the internet.

In order to understand the answer to this problem this case study followed these steps. The first step was to develop a list of EDI transactions Company A sends over a VAN. Second, the process flow was constructed of how a transaction is received from their suppliers and sent to their customers when done manually and by VAN EDI. From documenting the flow of these processes, a list of cost drivers needed for each step was created to understand the cost of each process. The final step was to compare the cost of each of these processes with the cost of sending these EDI transactions over the internet.

## List of Transactions

There are many EDI transactions that a company can send or receive with trading partners. Examples of these transactions are shown in Table 4. However, Company A only receives and sends an advance shipment notice. An advance shipment notice and the transaction set can be used to list the contents of a shipment
of goods as well as additional information relating to the shipment, such as order information, product description, physical characteristics, type of packaging, marking, carrier information, and configuration of goods within the transportation equipment (Superior Essex, 2000). Company A when sending this transaction is the organization responsible for detailing and communicating the contents of a shipment, or shipments, to one or more receivers of the transaction set (Superior Essex, 2000). Company A when receiving this information is the organization having an interest in the contents of a shipment or information about the contents of a shipment (Superior Essex, 2000).

In order for Company A to exchange an advance shipment notice, they use ANSI X12 standards. "X12 is a standard for defining Electronic Data Interchange (EDI) transactions from the American National Standards Institute (ANSI). X12 was the primary North American standard for defining EDI transactions (Cleo, 2005)." These standards determine what information is contained in the header and tables of the advance shipment notice. The advance shipment notice is labeled as an 856 under these standards.

The data for this case study was collected in two manners. The data pertaining to the EDI processes and cost were collected based on an analysis of Company A's EDI bill information. This information covered a four month period and a monthly average was calculated as given in Appendix B. The data collected for the manual process and cost was

provided by Company A's database. Both of the process flows were described by Company A's EDI specialist.

## Process Flow and Cost of Receiving an Advance Shipment Notice

Company A's total 856 files are split into two categories received and sent, and 41% of the total EDI files are received from suppliers. These received transactions are then broken down into five subcategories as shown in Table 16. One subcategory is an interchange which can be used during peak (6am-8pm) and off peak hours (8pm-6am), and these transactions make up 26.58% of the received 856 files. An interchange is a specific group for data segments that constitute a common business envelope as defined by the EDI standard being used, such as ANSI X12 (GXS, 2001). Company A can receive interchanges through the use of interconnects during peak (6am-8pm) and off peak hours (8pm-6am), and this method is used to receive 33.78% of the 856 files. The interconnect is only used when Company A's VAN has to connect to another VAN to receive an 856 file. The fifth method of receiving an 856 file is a document received by an interconnect, which is used 39.64% of the time. Public EDI standards, such as ANSI X12 refer to a document as a transaction set or message, such as an 856.

**Table 16: Breakdown of Received 856 Files by a VAN**

| Type of Received 856 Files | Occurences over 4 months | % of Received 856 |
|---|---|---|
| Interchange (peak) | 18 | 8.11% |
| Interchange (off peak) | 41 | 18.47% |
| Interchanges received by interconnect (peak) | 25 | 11.26% |
| Interchanges received by interconnect ( off peak) | 50 | 22.52% |
| Documents received by interconnect | 88 | 39.64% |
| Total | 222 | |

**Process Flow Diagrams**

The process flow diagram (Figure 31) describes how Company A receives an advance shipment notice for both the manual and VAN EDI process. The figures have a header that reflects what process is being broken down, and they also contain three symbols. Company A receives 90% of their advance shipment notices over EDI, and only 10% is conducted manually based on value of purchases.

The process flow diagram (Figure 31) below describes the steps needed for Company A to receive an advance shipment notice manually. Only 10% of the value of purchases made by Company A advance shipment notices are conducted manually. The total manual process has eight steps if the container coming from the supplier has a barcode label on it. If the container does not have a barcode, the process contains twelve steps, due to the addition of steps 1.2.1-1.2.4. Also, when the containers do not have barcodes, it adds twenty more minutes for unloading the truck which increases the total time of unloading the truck to fifty minutes. Only 10% of advance shipment notices conducted manually do not contain barcodes. So 90% of the manual advance shipment notices do contain barcodes. Company A also mentioned that of the containers that do not have barcodes 95% of them are from overseas.

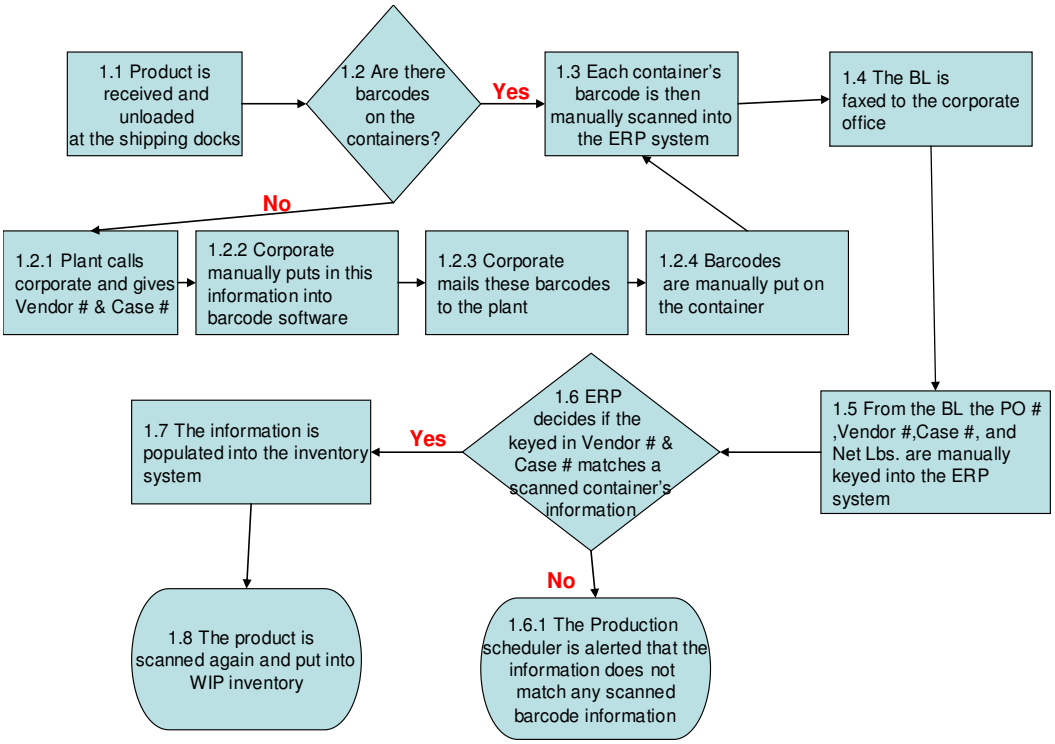


**Figure 31: Process Flow of Receiving an Advance Shipment Notice From a Supplier Manually**

Figure 32 displays the steps needed for Company A to receive an 856 EDI transaction over a VAN. Again 90% of Company A's value of raw material purchases' advance shipment notices or an 856 are done by EDI. In this process, eleven steps are needed to complete the transaction. All suppliers that offer this capability have a barcode system that contains needed information about the products contained in the container.

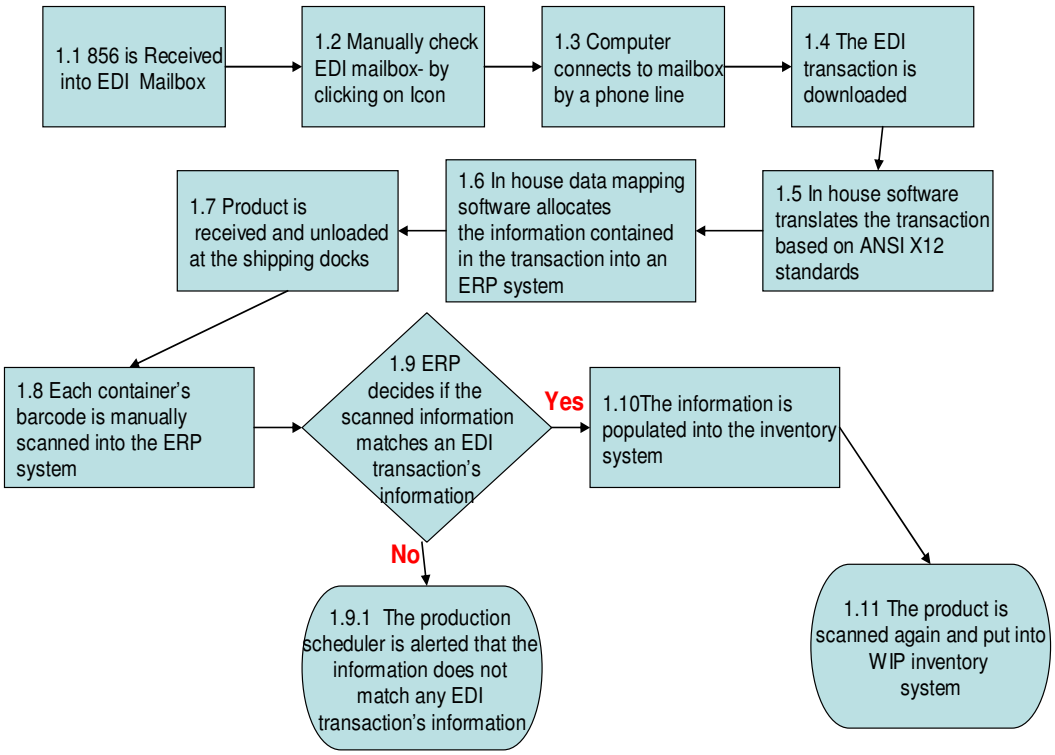


**Figure 32: Process Flow of Receiving an Advance Shipment Notice From a Supplier Using EDI over a VAN**

## Comparison of Processes

The manual process has fewer steps than the EDI process 90% of the time based on if the containers coming in have a barcode. But the manual process has more manual labor included when the data are entered into the system. The manual process with a barcode contains two steps, where the data of the product is handle by a person (1.4 and 1.5), and when a product does not have a barcode manual interaction is needed in 4 steps (1.2.1, 1.2.2, 1.4, and 1.5). Compared to the EDI process, the data is never entered or handled by an person.

This elimination has allowed Company A to reduce the number of data errors in their system and to improve their ability to manage their raw material inventory. When an employee of Company A is performing these steps in the manual process it is decreasing the amount of time the employee can spend on value added tasks, and also adds time to the process of receiving an advance shipment notice. This increase in time decreases the amount of advance planning Company A can do with the raw material coming in. In the EDI process Company A will have visibility of the raw material as soon it is downloaded into their system compared to the manual process where they must wait in till the product is at their docks.

**Process Cost**

The cost for both the manual and EDI process has been broken down into the cost to implement it or initial cost, monthly cost to run this system, and cost accrued per transaction. The EDI process using data from a four month average EDI bill for Company A to calculate transaction and monthly cost, and the EDI Bill is located in Appendix B. The cost is broken down by the steps in the process flow diagrams above. The cost drivers that are needed to perform each step are listed beside it and the one time, monthly, and transaction cost is provided next to each driver.

Table 17 provides the cost of performing Company A's manual process for receiving an advance shipment notice. The total initial cost for performing this process is $4,439 US. The manual process initial costs are driven by four drivers the barcode printer, printer software, scanning gun, and scanning software. The total cost of these four drivers is $3,890 and 87% of the total initial cost. Other initial costs that are accrued during this process are programming labor, training, database software, and fax machines.

The monthly cost for the drivers is calculated by multiplying the transaction cost by ten for the manual process. It is multiplied by ten because that is average amount of manual advance shipment notices Company A receives per month. By explaining the transaction cost it will also describe how the monthly cost is allocated. The transaction cost is $15.58 for this process and is only made up of labor cost drivers. The labor drivers are warehouse, clerical, and employee. Warehouse labor totals $8.84 of cost per transaction, and which represents 57% of the cost per transaction. Clerical is $4.44 and employee is $2.50 per transaction, and that is 43% of the cost per transaction

**Table 17: Cost for Receiving an Advance Shipment Notice when using a Manual Process**

| Step # | Action Performed | Cost Drivers | Initial Cost | Cost($/Transaction) | Cost($/Month) |
|---|---|---|---|---|---|
| 1.1 | Product is received and unloaded at the shipping docks | *Warehouse Overhead | | 2.50 | 25.00 |
| 1.2 | Determine if barcodes are on the containers | *Warehouse Overhead | | 0.17 | 1.67 |
| | **Yes- Go to Step 1.3 : No then the cost includes steps 1.2.1-1.2.4** | **Programming Cost (.5hr) | 10.00 | | |
| | | Barcode Printing Software (Bartender Software) | 390.00 | | |
| | | Barcode Printer | 2000.00 | | |
| | | ***Clerical Overhead | | 0.08 | 0.83 |
| | | Mailing Rate | Free sent by in house truck drivers | | |
| 1.3 | Each container's barcode is then manually scanned into the ERP system | Gun & Scanning Software | 1500.00 | | |
| | | Warehouse Overhead | | 2.83 | 28.33 |
| | | **Programming Cost (4hrs) | 80.00 | | |
| 1.4 | The BL is then fax to the corporate office | 2 Fax Machines | 100.00 | | |
| | | *Warehouse Overhead | | 3.33 | 33.33 |
| | | ***Clerical Overhead | | 0.83 | 8.33 |
| 1.5 | From the BL the PO# , Vendor #, Case #, and Net lbs is then manually keyed into the ERP System | Clerical Overhead | | 3.33 | 33.33 |
| | | *****Database Software | 229.00 | | |
| 1.6 | ERP system decides if the keyed in Vendor # & Case # matches a scanned container's information | **Programming Cost (4hrs) | 80.00 | | |
| | **Yes go to step 1.7 : No go to step 1.6.1** | | | | |
| 1.6.1 | The production scheduler is alerted that the information does not match any EDI transaction's information | | | | |
| 1.7 | The information is populated into the inventory system | **Programming cost (1hr) | 20.00 | | |
| 1.8 | The product is then scanned again and put into WIP inventory system | Gun & Scanning Software | 0.00 | | |
| | | ****Training Cost | 30.00 | | |
| | | Programming Cost | 0.00 | | |
| | | ****Employee Overhead | | 2.50 | 25.00 |
| | | Total | **4439.00** | **15.58** | **155.83** |
| * | Warehouse overhead= $10/hr | | | | |
| ** | Programmer overhead= $20/hr based on information from Wall Street Journal | | | | |
| *** | Clerical overhead= $10/hr | | | | |
| **** | Employee overhead=$10/hr | | | | |
| ***** | Microsoft Access= $229 | | | | |
| Takes 30 mins to unload truck and to scan raw material with barcodes | | | | | |
| Takes 50 mins to unload truck and to manually input raw material barcodes | | | | | |

Table 18 provides the total cost for the drivers needed to receive an 856 by EDI from Company A's suppliers. The total initial cost to perform this process is $4,894.00 US. Two

drivers programming and a barcode gun and software total $3,560, and which makes up 72% of the initial cost for this process. The other drivers that make up the other 28% of the initial cost are PC ($750), phone modem ($25), communication software ($300), database software ($229), and training ($30).

The monthly costs are not calculated the same way as the manual, but instead they are monthly averages from the EDI Bill located in Appendix B. The transaction cost in step 1.1, (except for the mailbox fee, interconnect fee, all KC fees, and Van user fee), are calculated by multiplying the percentages located in Table 16 for each method of receiving an EDI file by the rate charged for this service by Company A's VAN provider. These VAN rates are located in the EDI Bill in Appendix B. In this process the monthly costs also include VAN monthly fees, and these fees are: mailbox and interconnect. The mailbox fee is $100 a month no matter how many transactions occur over this time. In this cost analysis for this process a $41 fee was charged based on that only 41% of the EDI transactions are received files. A fee of $39 is charged each time the VAN has to connect with a 3rd party network, and only one of their suppliers has a 3rd party network.

There are two drivers for the cost per transaction when performing the EDI process, and which are labor and VAN costs. The labor costs represent 61% of the transaction cost. Labor cost include warehouse overhead which is a total of $5 for each transaction or 41% and employee overhead at $2.5 for each transaction or 20%. The second driver for this process is the cost accrued when using a VAN and these costs add up to be $4.82 or 39% of the cost per transaction.

## Table 18: Cost for Receiving an Advance Shipment Notice when using an EDI VAN Process

| Step # | Action Performed | Cost Drivers | Initial Cost | Cost($/Transaction) | Cost($/Month) |
|---|---|---|---|---|---|
| 1.1 | 856 is received into EDI mailbox | Mailbox Fee | | | 41.00 |
| | | 3rd Party Interconnect Fee ($39/occurrence) | | | 39.00 |
| | | Interchanges Received (Peak hrs) | | 0.02 | 1.04 |
| | | KC (Peak) | | 0.83 | 4.14 |
| | | Interchanges Received (Off Peak hrs) | | 0.04 | 2.25 |
| | | KC (Off Peak) | | 0.25 | 9.38 |
| | | Interchanges Received by Interconnect (Peak) | | 0.05 | 1.44 |
| | | KC Interconnect (Peak) | | 0.78 | 5.01 |
| | | Interchanges Received by Interconnect (Off Peak) | | 0.05 | 2.75 |
| | | KC Interconnect (Off Peak) | | 0.77 | 9.37 |
| | | Documents Received BY Interconnect | | 0.10 | 5.50 |
| | | KC Document Interconnect | | 1.02 | 21.95 |
| | | Van User Fee | | 0.15 | 8.20 |
| 1.2 | Manually Check EDI mailbox for new transactions | PC | 150.00 | | |
| | | *Programming Cost (3 hrs to create program) | 60.00 | | |
| 1.3 | Computer connects to EDI mailbox by a phone line | Phone Modem | 25.00 | | |
| | | *Programming Cost (3 hrs) | 60.00 | | |
| | | Communication Software | 300.00 | | |
| | | Session (connection) Fee (Off Peak) | | 0.20 | 2.71 |
| | | Session (connection) Fee (Peak) | | 0.18 | 1.22 |
| | | Dial out Service | | 0.17 | 9.40 |
| 1.4 | The EDI transaction is then downloade | *Programming Cost for Developing Script (4 hrs) | 80.00 | | |
| 1.5 | In house software translates the transaction based on ANSI X12 standards | *Programming Cost -In house translation software (40 hrs) | 800.00 | | |
| | | *Maint. Cost (2 hrs/new supplier) | 40.00 | | |
| | | PC | 600.00 | | |
| 1.6 | In house data mapping software then allocates the information contained in the transaction into an ERP system | *Programming Cost-In house data mapping software (40hrs) | 800.00 | | |
| | Information included-(PO#, Net Weight/Case, Vendor Part #, Invoice #) | ****Database software | 229.00 | | |
| | | *Maint. Cost (2 hrs/new supplier) | 40.00 | | |
| 1.7 | Product is then received and unloaded at the shipping docks | **Warehouse Overhead | | 2.50 | 138.75 |
| 1.8 | Each containers barcode is then manually scanned into the ERP system | **Warehouse Overhead | | 2.50 | 138.75 |
| | | *Programming Cost (4 hrs) | 80.00 | | |
| | | Gun & Scanning Software | 1500.00 | | |
| 1.9 | ERP decides if the scanned information matches an EDI transaction's information | *Programming Cost (4 hrs) | 80.00 | | |
| | **Yes go to step 1.10 : No go to step 1.9.1** | | | | |
| 1.9.1 | The production scheduler is alerted that the information does not match any EDI transaction's information | | | | |
| 1.10 | The information is populated into the inventory system | *Programming cost (1hr) | 20.00 | | |
| 1.11 | The product is then scanned again and put into WIP inventory system | Gun & Scanning Software | 0.00 | | |
| | | ***Employee Training Cost | 30.00 | | |
| | | *Programming Cost | 0.00 | | |
| | | ***Employee Overhead | | 2.50 | 138.75 |
| Extra | Management Report, Print Format | Per page | | 0.18 | 9.96 |
| Extra | Document/Interchange Storage | Per KC Per day | | 0.03 | 1.85 |
| | | **Total** | **4894.00** | **12.31** | **592.40** |
| * | Programmer overhead= $20/hr based on information from Wall Street Journal | | | | |
| ** | Warehouse overhead= $10/hr | | | | |
| *** | Employee overhead= $10/hr | | | | |
| **** | Microsoft Access= $229 | | | | |

**Cost Comparison of Receiving Processes**

Table 19 compares the initial and transaction cost of the two processes. When the monthly cost is compared the VAN process already has $80 of automatic fees built in, which consist of: Mailbox and Interconnect Fees. The EDI initial cost is $455 higher for the initial investment, because of the programming, PC, phone modem, and communication software charges. Even though the EDI process has more drivers for the total initial cost the manual process cost is only $455 lower, due to the $2350 for the extra barcode printer and software.

**Table 19: Receiving Processes Cost Comparison**

| Cost | Manual Receiving Process($) | EDI VAN Process ($) | Difference from Manual and EDI ($) |
|---|---|---|---|
| **Initial** | 4439 | 4894 | -455 |
| **Transaction** | 15.58 | 12.31 | 3.27 |

The cost per transaction for the EDI process is $3.27 less than the manual process, based on the amount of labor built into each process. The drivers for the EDI initial cost help eliminate all of the labor cost that was in the manual process. The manual process cost per transaction is made up of the 100% labor charges compared to the 61% in the EDI process. Even though the EDI process has $4.82 of VAN charges the amount labor needed to perform this process is more than these charges.

Since there is a savings per transaction from using the EDI process it will take 1497 EDI transactions to breakeven the initial cost of $4894. This number of transactions would be conducted over a twenty seven month period based on there is 55.5 transactions a month. If Company A keeps on receiving 55.5 transactions a month with the EDI process they will save $181.49 per month.

## Process Flow and Cost of Sending an Advance Shipment Notice

Company A is not only receiving advance shipment notices they are also sending this information to their customers. Of the total EDI file transactions 59% is made up of sent transactions by Company A, and which adds up to an average of 81 occurrences a month based on the four month period in the EDI bill. The breakdown in the manner of how these files are sent is shown in Table 20. Interchanges sent to an interconnect are used 59.26% of the time, and a document sent to an interconnect is used 38.58% of the time. Interchanges and documents sent to Company A's customers make up the other 2% of the 856 sent by EDI. Even though more files are sent over the VAN than received there are by far more advance shipment notice sent manually per month at a rate of 196.

**Table 20: Breakdown of Sent 856 Files by a VAN**

| Type of Sent 856 Files | Occurrences over 4 months | % of Sent 856 |
|---|---|---|
| Interchange (peak) | 6 | 1.85% |
| Interchanges sent to interconnect (peak) | 192 | 59.26% |
| Documents sent | 1 | 0.31% |
| Documents sent to interconnect | 125 | 38.58% |
| **Total** | **324** | |

## Process Flow Diagrams

Based on Company A's sales volume 50% of the advance shipment notices are sent by EDI and the other 50% by the manual process. This is true even though there are 2.4 more manual transactions per month when compared to the amount of 856 files sent by EDI. The processes flow diagrams for both of these processes are described below.

Figure 33 contains the process flow that Company A follows to send an advance shipment notice to their customers. This process is simplistic when compared to both of the receiving processes based on the number of steps included. The manual process only is made up of four total steps. All four of these steps include a customer service representative to perform each of their functions since none of them are automated.

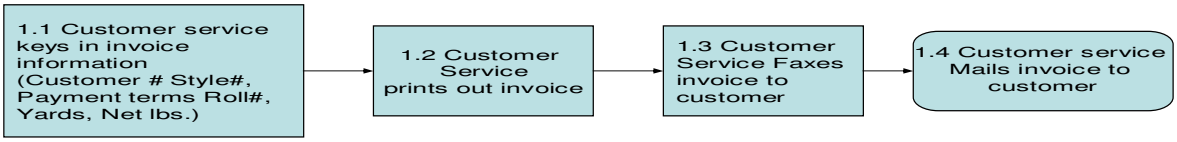


**Figure 33: Process Flow of Sending an Advance Shipment Notice to a Customer Manually**

The EDI process for sending out an 856 file to the customer has a total of seven steps to complete this process. This process starts off in the same manner as the manual process, but after that the data entry in the remaining steps are automated. The EDI process is illustrated in Figure 34, and from this diagram it shows how the EDI technology automates the remaining steps.

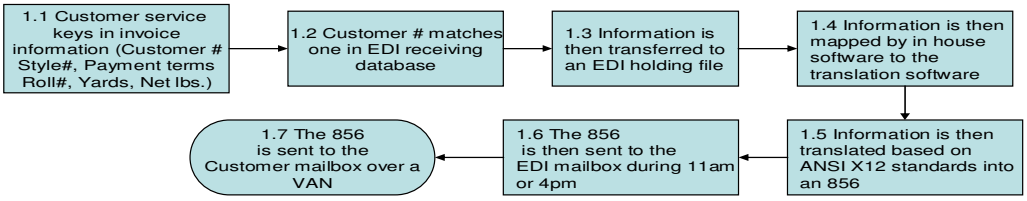


**Figure 34: Process Flow of Sending an Advance Shipment Notice to a Customer when using a VAN**

## Process Comparisons

When comparing these processes the manual process has three fewer steps than the VAN process. Even though the manual has fewer steps Company A prefers the VAN process, because of its data accuracy and the reduction of employee interaction. Company A feels this automated process has allowed their customer service representatives to focus on more value added activities. The increase in data accuracy has allowed the company to trust the system's information to better manage the logistics and their finish goods inventory. This VAN process has also improved their customer service levels by adapting the way their customers' business practices are set up.

## Process Cost

The tables containing the cost information are set up in the same manner as the tables costing the receiving processes. Table 21 contains the cost information for the manual sending process. This process only needs $130 to set this system up. The initial cost is made

up of a printer ($80) and a fax machine ($50). There are no other initial charges accrued for the manual process.

Since this system does not have any automated steps the monthly and cost per transaction is 84% labor fees. The only other cost built in is the mailing fees at $.39 per transaction for stamps. The monthly cost in Table 21 is calculated by multiplying the cost per transaction for each step by 196, since this is the monthly average of manual transaction sent out.

**Table 21: Cost for Sending an Advance Shipment Notice when using a Manual Process**

| Step # | Action Performed | Cost Drivers | Initial Cost | Cost($/Transaction) | Cost($/Month) |
|---|---|---|---|---|---|
| 1 | Customer service keys in invoice information- (Customer #,Style #, Payment terms, Roll #, Yards, Net lbs.) | *Clerical Overhead | | 0.17 | 32.67 |
| 2 | Prints out invoice | *Clerical Overhead | | 0.17 | 32.67 |
| | | Printer | 80.00 | | |
| 3 | Fax printout to the customer | *Clerical Overhead | | 0.83 | 163.33 |
| | | Fax machine | 50.00 | | |
| 4 | Mails the printout to the customer | *Clerical Overhead | | 0.83 | 163.33 |
| | | Mail fees | | 0.39 | 76.44 |
| | | Total | 130.00 | 2.39 | 468.45 |
| | | | | | |
| * | Clerical overhead= $10/hr | | | | |

The cost to implement the VAN process was $3,124 as shown in Table 22. The major driver of this cost was programming which totaled $1,820 or 58% of this process's initial cost. PC cost is the second largest driver with a total of $750 or 24%. The remaining 18% is made up of communication software, phone modem, and database software fees.

The VAN monthly costs are not calculated the same way as the manual, but instead they are monthly averages from the EDI Bill located in Appendix B. The transaction cost in step 1.7, (except for the interconnect fee and all the KC fees), are calculated by multiplying

the percentages located in Table 20 for each method of sending an EDI file by the rate charged for this service by Company A's VAN provider. These VAN rates are located in the EDI Bill in Appendix B. In this process the monthly costs also include VAN monthly fees, and these fees are: mailbox and interconnect. The mailbox fee is $100 a month no matter how many transactions occur over this time. In this cost analysis for this process a $59 fee was charged based on that 59% of the EDI transactions are sent files. A fee of $39 is charged each time the VAN has to connect with a 3rd party network, and Company A has to connect to three interconnects so its total is $117.

There are two drivers for the cost per transaction when performing the EDI process, and which are labor and VAN costs. The VAN drivers make up 93% of the cost per transaction for this process with a total of $2.25. The VAN costs include everything accrued per transaction except the clerical labor. The clerical labor is $.17 per transaction or 7% of the total transaction cost.

## Table 22: Cost for Sending an Advance Shipment Notice when using a VAN

| Step # | Action Performed | Cost Drivers | Initial Cost | Cost($/ Transaction) | Cost($/Month) |
|---|---|---|---|---|---|
| 1.1 | Customer service keys in invoice information- (Customer #, Style #, Payment terms, Roll #, Yards, Net lbs.) | *Clerical Overhead | | 0.17 | 13.46 |
| | | PC | 600.00 | | |
| 1.2 | Customer # matches one in EDI receiving database | **Programming cost (1hr) | 20.00 | | |
| | | ***Database Software | 229.00 | | |
| 1.3 | Information is then transferred to an EDI holding file | **Programming cost (3 hr) | 60.00 | | |
| 1.4 | Information is then mapped by in house software to the translation software | **Programming Cost-In house data mapping software (40 hrs) | 800.00 | | |
| | | Maint. Cost (2hrs) | 40.00 | | |
| 1.5 | Information is then translated base on ANSI X12 standards into an 856 | Programming Cost -In house translation software (40hrs) | 800.00 | | |
| | | Maint. Cost (2hrs) | 40.00 | | |
| | | PC | 150.00 | | |
| 1.6 | The 856 is then sent to the EDI mailbox during 11am or 4pm | Phone Modem | 25.00 | | |
| | | **Programming Cost (3hr) | 60.00 | | |
| | | Communication Software | 300.00 | | |
| | | EDI Mailbox Fee | | | 59.00 |
| | | VAN user Fee | | | 11.80 |
| | | Session (connection) Fee (Peak) | | 0.20 | 3.89 |
| | | Session (connection) Fee (Peak) | | 0.18 | 1.75 |
| | | Dial out Service | | 0.17 | 13.53 |
| 1.7 | The 856 is then sent to the Customer's mailbox over a VAN | 3rd Party connection fee ($39/user) | | | 117.00 |
| | | Interchanges sent (Peak) | | 0.00 | 0.35 |
| | | KC (Peak) | | 0.13 | 0.80 |
| | | Interchanges sent by interconnect (Peak) | | 0.14 | 11.04 |
| | | KC interconnect (Peak) | | 0.45 | 21.75 |
| | | Documents sent | | 0.00 | 0.06 |
| | | KC Document sent | | 0.09 | 0.10 |
| | | Documents sent to interconnect | | 0.10 | 7.81 |
| | | KC Document Interconnect | | 0.58 | 19.11 |
| Extra | Management Report, Print Format | Per page | | 0.18 | 14.34 |
| Extra | Document/Interchange Storage | Per KC Per day | | 0.03 | 2.67 |
| | | Total | 3124.00 | 2.42 | 298.45 |
| | | | | | |
| * | Clerical overhead= $10/hr | | | | |
| ** | Programmer overhead= $20/hr based on information from Wall Street Journal | | | | |
| *** | Microsoft Access= $229 | | | | |

**Cost Comparison of the Sending Processes**

Table 23 compares the initial and transaction cost of the two processes. When monthly cost is compared the VAN process already has $176 of automatic fees built in before any transactions are made, and which consist of: Mailbox and Interconnect fees. The EDI's initial cost is $2994 higher for the initial investment, because of the programming, PC, phone modem, and communication software charges.

**Table 23: Sending Processes Cost Comparison**

| Cost | Manual Sending Process($) | EDI VAN Process ($) | $ Difference from Manual and EDI |
|---|---|---|---|
| Initial | 130 | 3124 | -2994 |
| Transaction | 2.39 | 2.42 | -0.03 |

The cost per transaction for the EDI process is $.03 more than the manual process. Even though there is a higher cost of doing business with their customers Company A must use the EDI process. If they did not use this process they would not have a strong relationship with their EDI using customers, because it would make it harder for the customers to do business with them. The only advantage for using the manual process is the lower cost of investment and the $.03 savings per transaction. But, the EDI process allows Company A's employees to focus on more value added tasks and to have an increase the accuracy of their supply chain information.

# Internet EDI

This case has now analyzed the cost and process of sending and receiving an advance shipment notice or an 856. This section will describe the costs and process affiliated with a technology that would allow Company A to eliminate the VAN charges when

exchanging information electronically. The technology that was analyzed was Applicability Statement 2 (AS2). AS2 is a standard created by the Internet Engineering Task Force (IETF) for exchanging business documents over the Internet in a secure manner (Radko, 2002). The software is set up to connect to the trading partner periodically and check for files that need to be exchanged. The VAN is then not needed as the services they provide are performed by the AS2 software. This is why Wal-Mart and other mass merchants are requiring it now for their suppliers (Ferguson, 2002).

**AS2 Process**

The AS2 software would handle the encryption, communication, and receipt verification required by this standard protocol. If Company A and their trading partner implemented this technology they both would hold "keys" to un-encrypt the data at each end. That way no one can intercept the data and nothing else but the exchanged files can be shared through the AS2 software. This process is performed in four steps as shown in Figure 35 . AS2 places a document in an envelope and encrypts it with a digital certification. This document can be as simple as an Excel spreadsheet or a document written in XML. When the document arrives at its destination, the software on a user's desktop decodes the document and is integrated into their enterprise system.

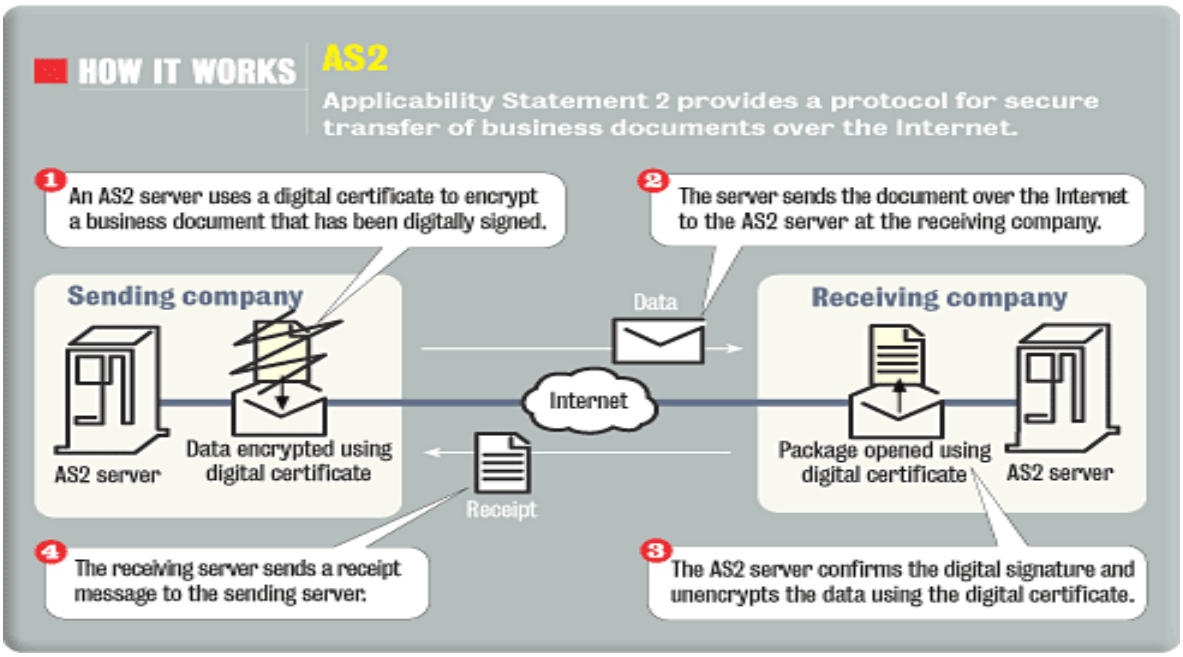


**Figure 35: AS2 Process**

Radko, J. (2002). AS2 secures documents using the web. Retrieved March 3, 2006, from Network World website http://www.networkworld.com/news/tech/2002 /1209techupdate. html?page=1

In order to understand what information Company A would need to know to implement this software into their existing EDI system phone interviews were conducted with software industry representatives. Representatives from Data Communication Solutions Inc. (DCS) which has over fourteen years of experience with EDI implementations were the only ones to respond (DCS, February15, 2006). After describing Company A's EDI process to DCS they stated," the mapping part of the system will be the same but Company A would have to reprogram the translation software to face the AS2 software instead of the VAN." According to DCS Company A should select AS2 software based on if it is compatible with their operating system and firewall is on and the brand of firewall they use. A list of certified AS2 vendors that have been certified "e-business ready" by the Drummond Group is shown in Table 24.

**Table 24: AS2 Vendors**

| Company | Company Website |
|---|---|
| Alligacom | www.alligacom.com |
| Boomi | www.boomi.com |
| Cleo Communications | www.cleo.com |
| iSoft | www.iSoft.com |
| webMethods | www.webMethods.com |

Source: Buxbaum, P. (2003). Egotism may be socially incorrect but for retailers it pays to be shelf-involved. *Operation System and Fulfillment*, August, 2003, 26-29.

AS2 software implementation presents new challenges to smaller and medium size companies like Company A. First AS2 requires a computer to be hook up to a computer 24 hours 7 days a week (Radko, 2002). Second since this process uses digital certificates Company A must know how to manage them. These certificates can be revoked at any time, and which will expire periodically (Radko, 2002). The expired certificates are renewed with new certificates and they are imported manually to the AS2 software (Radko, 2002). These challenges should also be included into the factors when choosing an AS2 software package.

## AS2 Cost

The implementation, monthly, and transaction cost include three cost drivers for Company A since they already have an EDI system in place. These cost drivers are software, programming, and maintenance fees as shown in Table 25. The cost per trading partner is different if Company A uses the same AS2 software package with each.

The cost for company A when implementing AS2 software for the first time with a trading partner will include these three cost drivers. All of the cost included in this analysis was collected during the phone interviews with DCS. AS2 software packages' prices range from $1500-$5000 based on what size of server a company has. DCS recommended to use a software package price of $2500 based on Company A's information. This software package would include features that would handle the encryption, communication, and receipt

verification steps in the process. DCI recommends not to use a software package if they charge additional software cost for using the software with additional trading partners.

**Table 25: AS2 Cost**

| Cost Driver | 1st Trading Partner ($) | Additional Trading Partner |
|---|---|---|
| Software* ($) | 2500 | 0 |
| Programming** ($) | 1500 | 375 |
| Maintenance ***($) | 450 | 0 |
| Total ($) | 4450 | 375 |

* Average AS2 Software cost

** 125/hr

*** 18% of software fees and is yearly

Source: DCS, 2006

The second cost driver is programming fees. DCS recommended that the average hourly cost for a programmer with AS2 implementation experience would be $125 per hour. The average time it takes to set up the first trading partner is 12 hours. These 12 hours would include setting up the software and testing it with the trading partner. So the total programming cost would be $1500 for the first trading partner implemented. There is a $375 charge for any additional trading partners implemented. This cost is based on the same programming cost per hour and that it would take 3 hours to program the needed changes.

The final cost driver for implementing AS2 software is maintenance fees. According to DCS an AS2 software provider should charge 18% of the total software costs per year for maintenance. This maintenance would include new encryptions and certificates needed to exchange the needed information. Based on the total software cost of $2500 the maintenance fee per year is $450. Once the system is setup there are no further costs. No monthly bills from the AS2 provider or programming charges unless additional technical support is needed.

In order to calculate the monthly and cost per transaction for Company A if they used AS2 software all VAN charges were eliminated from the EDI sending and receiving process. The transaction cost for receiving an 856 by AS2 software would cost $7.5 consisting of only warehouse labor charges. The total investment for Company A to achieve this transaction cost would be $7000. This $7000 is made up of $4000 for AS2 programming and software fees for the first trading partner implemented. The remainder is made up of the $375 of programming fees for each additional vendor implemented. Since they have a total of 9 suppliers using EDI then 8 partners would only cost $375 to implement and that would be equal to $3000. The monthly cost for this process would only be $37.5 based on the annual maintenance cost.

The transaction cost for Company A if they would use AS2 for sending advance shipment information would be $.17. This is made up of the customer representative overhead cost it takes to key in the invoice information in the system. The implementation cost would be $2250 if Company A would implement this with a Vendor first. This cost would then be made up of 6 suppliers that were implemented at a rate of $375 per occurrence. The monthly cost would be the same as the receiving process.

## Process Cost Comparison

Case 1 has presented three different processes Company A could use to send and receive advance shipment notice information. This section compares the cost to implement these three processes and their cost per transaction. Based on this comparison it will show if the additional cost for implementing AS2 technology would create a savings for them.

**Receiving Process**

The cost per transaction based on what receiving process Company A performs with their supply chain is shown in Figure 36. Based on this information if Company A utilized AS2 technology it would cost $7.50 per transaction. AS2 utilization would create a savings of $8.08 per transaction when used instead of the manual process and would save $4.81 per transaction when used instead of the EDI process. The transaction savings per month if AS2 was implemented with all of their receiving EDI trading partners would be $266.95. This savings is based on if Company A's average of 55 transaction per month stayed the same.

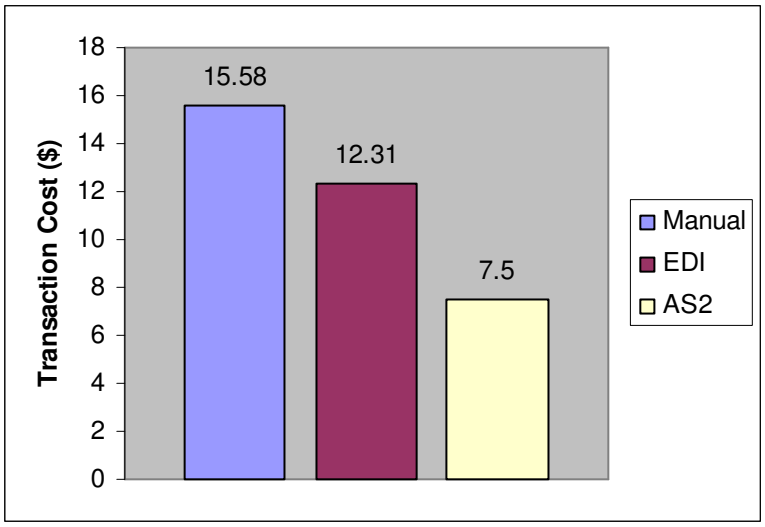


**Figure 36: Company A's Transaction Cost per Receiving Process**

There are additional monthly cost Company A accrues when using the EDI and AS2 receiving processes. These costs are shown in Figure 37. When Company A performs the EDI receiving process with their suppliers they pay a total of $80 per month in additional charges that are not included in the transaction cost. This cost has two drivers Interconnect fees of $39 per month and Mailbox fees of $41 per month. AS2 additional monthly cost however is only $15.38 for the yearly maintenance fees. The monthly maintenance fee was calculated by the dividing the yearly fee of $450 by 12 months and multiplied by 41%. 41%

was used since only 41% of the EDI transactions are received transactions. Company A would save $64.62 per month if they used AS2 technology instead of EDI technology.

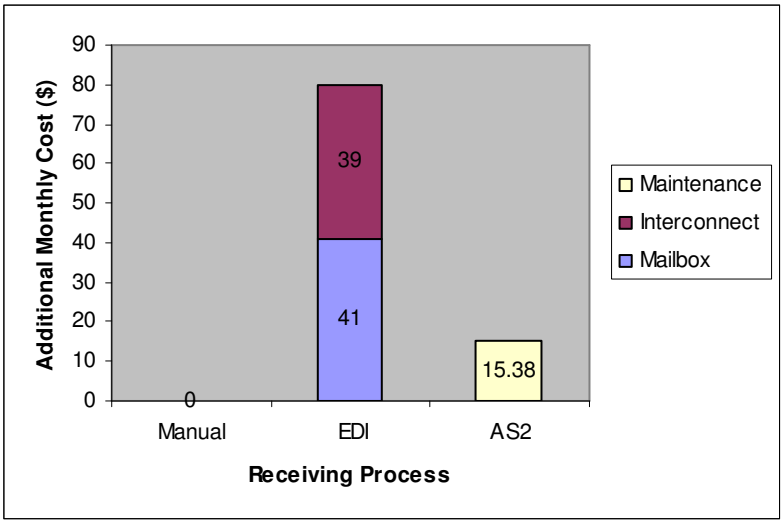


**Figure 37: Additional Monthly Cost per Receiving Process**

## Sending Process

The cost per transaction based on what process is used when Company A sends shipment information with their supply chain is shown in Figure 38. Based on this information if Company A utilized AS2 technology it would cost $.17 per transaction. AS2 utilization would create a savings of $2.22 per transaction when used instead of the manual process and would save $2.25 per transaction when used instead of the EDI process. The transaction savings per month if AS2 was implemented to replace all of their EDI transactions would be $182.25. This savings are based on if Company A's average of 81 transaction per month stayed the same.

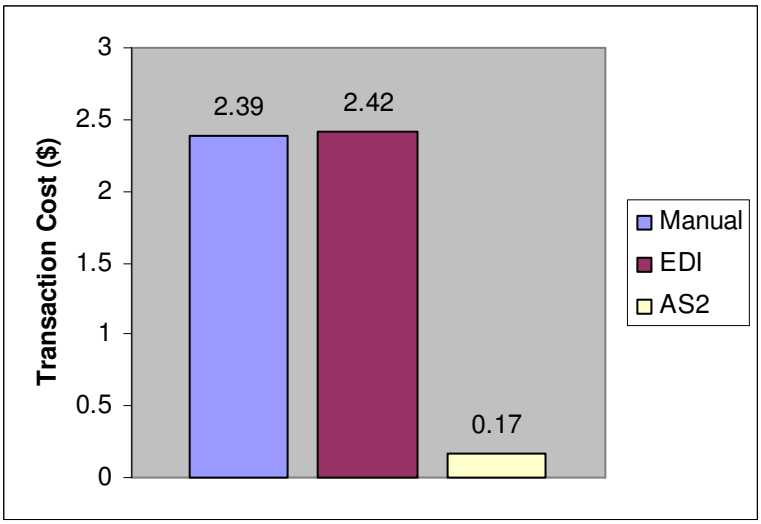


**Figure 38: Company A's Transaction Cost per Receiving Process**

There are additional monthly cost Company A accumulates when using the EDI and AS2 receiving processes. These costs are shown in Figure 39. When Company A performs the EDI sending process with their suppliers they pay a total of $176 per month in additional charges that are not included in the transaction cost. This cost has two drivers Interconnect fees of $117 per month and Mailbox fees of $59 per month. AS2 additional monthly cost however is only $22.13 for the yearly maintenance fees. The monthly maintenance fee was calculated by the dividing the yearly fee of $450 by 12 months and multiplied by 59%. 59% was used since only 59% of the EDI transactions are sent. Company A would save $153.87 per month if they used AS2 technology instead of EDI technology.

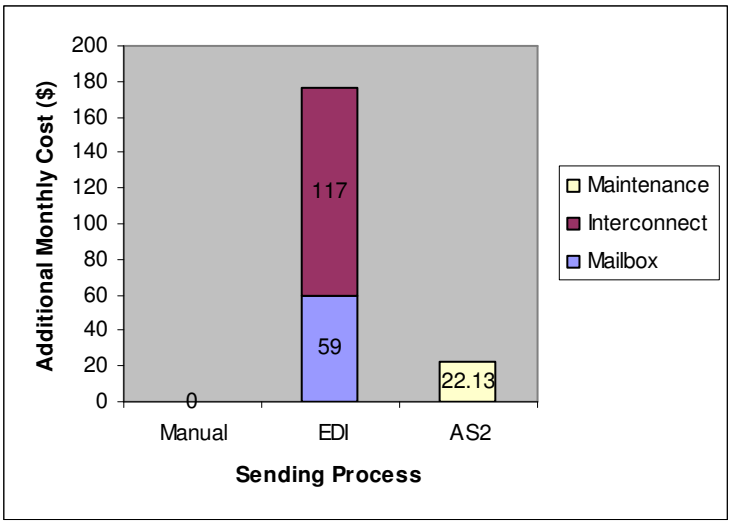


**Figure 39: Additional Monthly Cost per Sending Process**

## Total Savings

The receiving and sending section show that there are savings when replacing the EDI process with an AS2 process for Company A. In Figure 40 the total AS2 monthly savings are shown and are broken down into two areas transaction and additional monthly savings. The receiving process total savings per month would be $331.57 based on these two drivers. When implementing AS2 software for sending EDI transaction Company A would save $336.12 per month. The total savings for implementing AS2 in both of these processes is $667.69 per month or $8012.28 per year. AS2 processes were not compared with the manual process cost because Company A's trading partners that used this process do not have the capability to exchange information electronically.

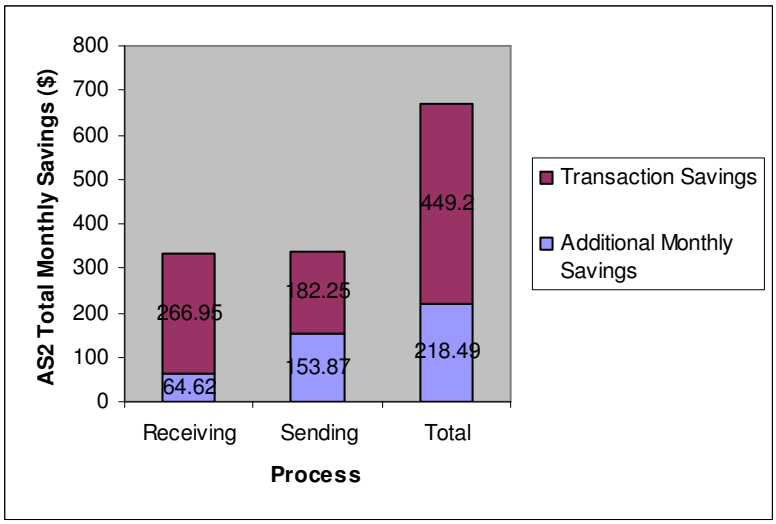


**Figure 40: AS2 Total Monthly Savings**

In order for Company A to implement AS2 software to replace their EDI transaction it will cost them $97000. However, based on the total monthly savings of $667.69 per month the payback period would only take 14 months. These savings are based on that all of their suppliers and customers would also implement AS2 software into their system. Getting all of their trading partners to implement AS2 would be the largest hurdle for Company A to overcome when choosing to implement this technology. However, this case has shown that the cost to implement this technology is not too high and the cost would be paid off in just 14.5 months of using this technology.

## Case Study 2

### Problem Description

Company B is a large US yarn manufacturer, and they have received an inquiry from their customer, Company C, to start displaying certain supply chain information on the internet. Company C is a US company that focuses on t-shirt manufacturing.

Company B is using an e-business module from their ERP system to develop this capability. The ultimate goal for Company B is to have their customers enter in their own orders on the internet and then have this information integrated with their ERP system. Company B needs to understand why their customers are starting to inquire about this communication tool and also what benefits does this create for their supply chain. This case explores the process flow and the hardware and software requirements for this information to be displayed on the internet.

Information to be provided on Company B's website may include:

1. Orders that have been shipped to Company C and how many orders are still left on their contract.
2. What orders are approved by Company C and what orders are pending for Company C's approval.

### E-business Module's Requirements & Capabilities

Company B's e-business module has certain hardware and software requirements in order for it to make their information visible on the internet. These requirements are then broken down based on if they are needed for the PC or ERP server (Table 26).

**Table 26: E-business Module's Requirements**

| PC Server Requirements | ERP Server Requirements |
|---|---|
| Processor with 1 Gb Ram | Database Software |
| Server | IBMServer |
| IBM Websphere Application Server v.5 | |

Company B is planning to use the module as a way to take in orders from their customer and also to allow their customers to have visibility of certain supply chain information. The e-business module has other capabilities that it can perform, and these are described in Table 27. The existing order inquiry process will allow Company B's customers to have visibility of their open orders and Company B's production and delivery plans to complete them. This module also allows their customers to see the orders that have already been shipped to them and the quantity of that shipment. The reordering capability gives the customer the opportunity to update their orders with Company B automatically. The stock availability option allows the customer to see if Company B has the stock in place to handle this updated order for certain products. Technical documentation download and master file information capabilities then allows the customer to update their records dealing with Company B.

**Table 27: E-Business Module's Capabilities**

| Module Capability | Description |
|---|---|
| Order Entry | Enter in new orders for any product |
| Existing Order Inquiry | Visibility of open order information<br>Company A's delivery & production plans dealing with open orders |
| Order History | Quantity & Delivery Date |
| Reordering | Copy old information & add to new order information |
| Stock Availability Information | Show warehouse balance of different articles |
| Technical Documentation Download | PDF, Microsoft, and other multimedia documents |
| Master File information | Price list of products<br>Customer file information (shipping information) |

**Information Process Flow**

In order for the information in Company B's ERP system to be visible on the internet it must follow certain steps. Figure 41, shows the overview of how Company B's e-business system works. The first step is for Company C to login into Company B's website set up by Company B's e-business module. Company C logging into their website makes Company B's web server pull certain information from their ERP server to display on the website. Company B's internal system is protected by a firewall that is placed between the internal network and the internet.

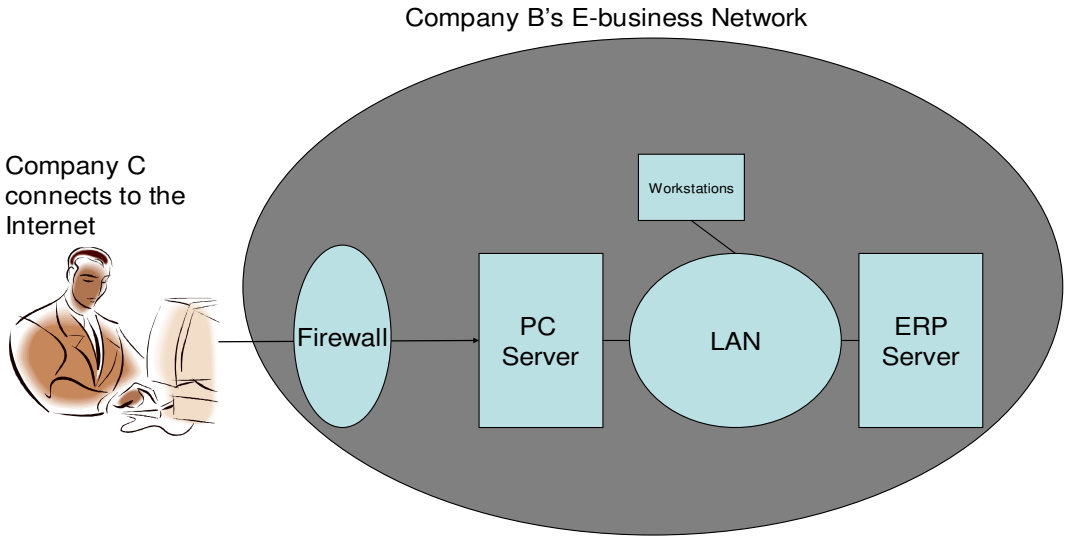


**Figure 41: Overview of Company B's E-business System**

The information flow described in the prior paragraph only describes a generic overview of the whole process. However, Figure 42 describes the process in more detail. Company B has a Websphere Application Server (WAS) which is a Java™-based application platform that integrates their enterprise data with the internet. The WAS also integrates any information that is keyed into Company B's website with their ERP system. Company C

logins into B's website the WAS then selects the enterprise information that was created for B's visibility. There are triggers that were programmed into the ERP database to transport this information to the e-business database, where the information is stored. Both of these databases are located on the ERP server. Based on the login information the e-business software then pulls the customer's information from the e-business database. This process is illustrated in Figure 42 below.

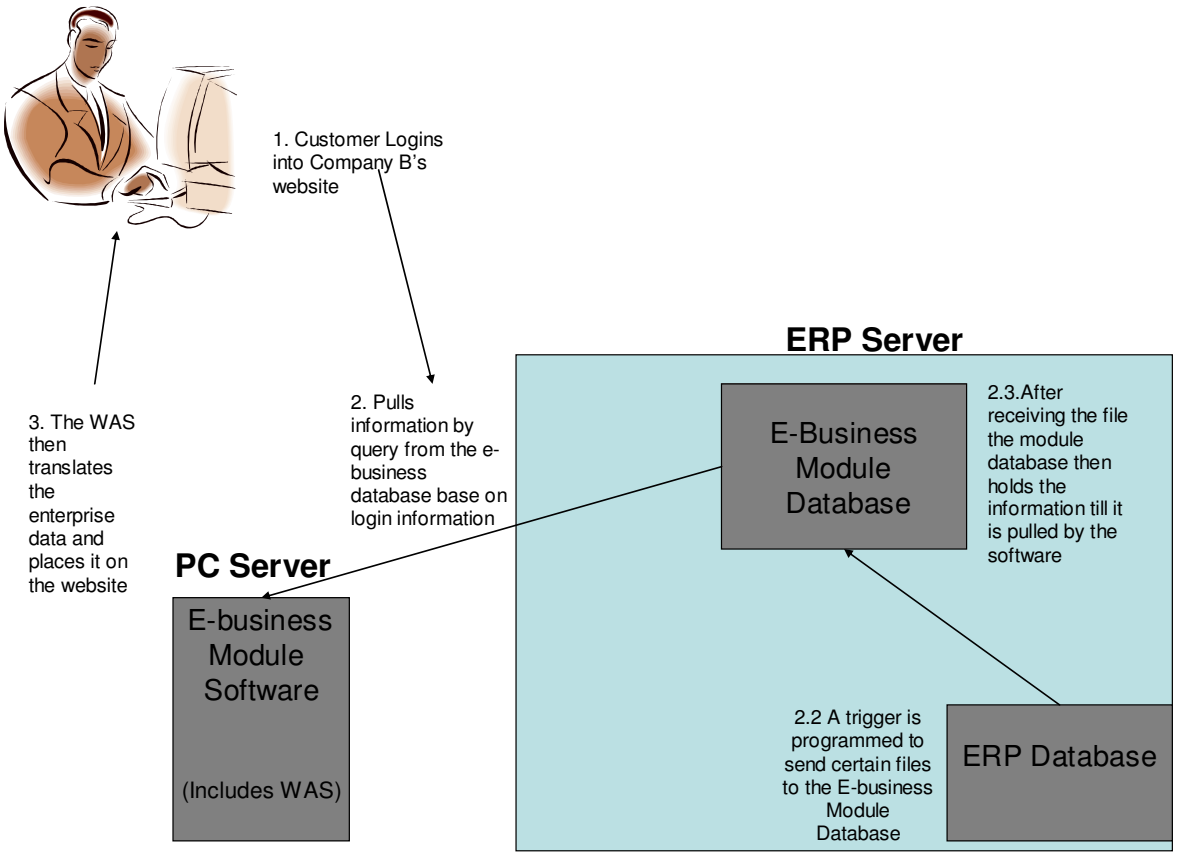


**Figure 42: A Detailed Perspective of Company B's E-business System**

## Benefits

The e-business module's capabilities provide Company B with benefits internally and externally. When Company B's customers use the order entry capability this will provide

them with real time reporting on order information. The module will also reduce the amount of non-value added tasks employed with the manual order entry process, and this can reduce transaction cost by eliminating overhead. Company B will also benefit when dealing with external customer's information, because the module will allow the company to distribute information in an easier manner.

The customer, Company C, inquired about exchanging information over the internet based on the thought of reducing cost in the supply chain, and this information was collected when Company C answered the following questions.

1. What was the driving force behind you asking for this web interface capability?
2. Are you presently using any e-business technologies? If so which technologies and why?
3. What were the barriers of using e-business in the past?
4. Is this type of e-business integration your top choice? If not what technology is?

Company C based this inquiry that Company B's e-business capabilities would allow them to have better visibility of their raw material inventory in the product's pipeline. This visibility would then allow them to manage their inventory and production planning based on this information.

Sharing information over the internet will be the first B-to-B e-business transaction between Company B and C. Both companies have e-business capabilities but the discussion of using them has not come up till now. The barriers for Company C from using e-business in the past were their system was not compatible with other systems and their lack of IT resources to spend time on handling e-business transactions. Company C's top choice for an

e-business technology is one that can be integrated with their system, so the business process will be totally automated.

Company C was given a list of the e-business module's capabilities which are shown in Table 27. They then selected the capabilities they felt that would create the most value for themselves and Company B. The results of which capabilities were selected by Company C are show in Table 28. Five out of the seven capabilities were selected and they were: Existing Order Inquiry, Reordering, Warehouse Inventory, Technical Documentation Download, and Yarn Quality Information. The two that were not selected are Order Entry and Order History.

**Table 28: Company C's Selection of the E-business Module's Capabilities**

| Information or Application | Company C wants it Displayed on Web | How would this information be used in your supply chain activities? | What value is created from your supplier exchanging this information? |
|---|---|---|---|
| Order Entry | No | Does not want this application unless integrated in their system | Would not create any value. Company B feels that it would increase this transaction cost because they would enter in the order twice. Once in Company A's system and then in their own |
| Existing Order Inquiry | Yes | Visibility of where the orders are in the product pipeline. It would show if it was in production, transit, or received | Increase the accuracy of planning. Reduce the amount of inventory. Increase the visibility of inventory information. |
| Order History | No | Has this in their own system | Does not create any value |
| Reordering | Yes | Would only be interested if it was integrated with their system. This information would be used for order management | Reduce time to reorder and increase the visibility of the product pipeline |
| Warehouse Inventory | Yes | Mange raw material inventory and ordering | Reduce raw material inventory |
| Technical Documentation Download | Yes | The application would be used to integrate information into their system | It is a necessity for this e-business system to be of any value |
| Yarn Quality Information | Yes | Would like yarn count and yarn count variation information. This would be used to understand if their raw material is causing a shortage of production | Understand raw material variation coming into the process |

Company C selected Existing Order Inquiry, Reordering, and Warehouse Inventory because it would increase their visibility of their raw material inventory. This visibility then

would allow them to reduce the raw material inventory and increase the accuracy of their production planning. The Technical Documentation Download application was selected because Company C thinks this would be a necessity in order for this system to work. Without this capability the two systems would not be integrated and the lack of integration would decrease the advantage of sharing information by this e-business module. Yarn Quality Information was not an original capability for this module, but Company C felt this would be very helpful if Company B could provide this information. The yarn count is the main quality information Company C wants. This information's value is created by allowing Company C to understand if the yarn count variation is affecting their production yield.

Order Entry and Order History were not selected because they would not be integrated into Company C's system. Since the two capabilities are not integrated with Company C's system they would increase the cost for them. The increase in transaction cost would come from having to enter in the order twice, once in their own system, and then into Company B's e-business module. Company C feels that the main value for Company B's e-business module would only be created if they can integrate these web applications into their system. They would rather use EDI if there is no integration between the two companies, because at least EDI would decrease their transaction cost.

## Case Study 3

### Problem Description

Company D is a textile manufacturer that focuses on producing fabric for technical and upholstery markets and they were faced with the reducing costs with relation to communicating with their supply chain partners. This cost reduction was based on Company D's initiative to increase their economic competitiveness and the availability of new e-business technology. They were accruing a great deal of monthly and transaction costs from communicating with their supply chain by VAN EDI but they developed an automated process to eliminate them. Case Study 3 describes the automated process that Company D created to eliminate the costs employed with using VAN EDI.

### Existing System

Company D's existing system's capabilities is what allowed them to develop this automated e-business system. The system is made up of five integral parts, and which are: a mail server, ERP server, Oracle database and tools, structured query language (SQL) loader, and scripts. The servers and database are responsible for storing the information through out the process. However, the SQL loader and scripts are being used to transport and translate the information. A SQL loader is responsible for requesting information from a database. Scripts are a list of commands that can be executed without user interaction. The sections below will describe in more detail how this system is used to send and receive B-2-B transactions in Company D's supply chain.

## Receiving Process

To initiate this process Company D must first setup their vendor with a username and password. The vendor's password information will then be linked with an email address. This email address then will be used to attach the shared data electronically to Company D's mail server. Once these steps have taken place the data will follow the process shown in Figure 43.

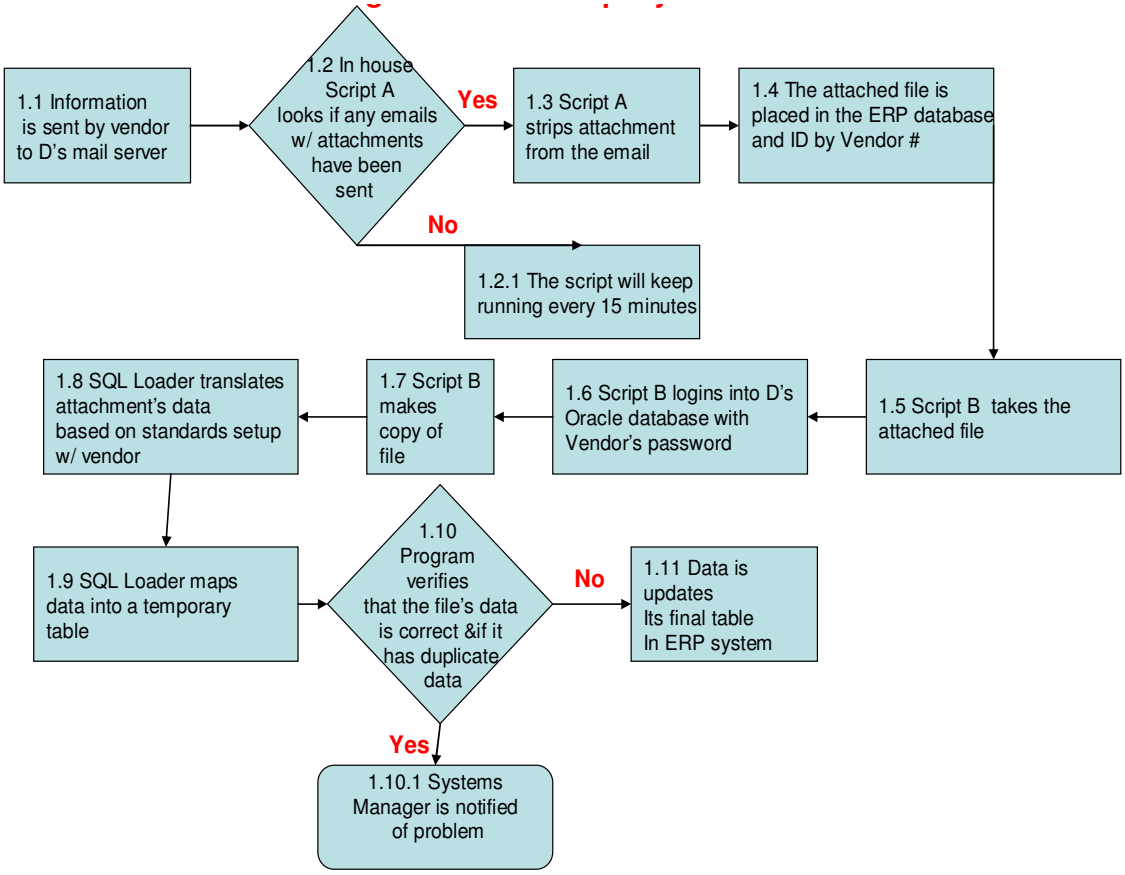


**Figure 43: Receiving Process Flow Diagram**

Once the email has been sent to Company D's mail server Script A was developed to transport this file to their ERP server. Script A has the capability to look for emails from certain vendors, strip attachments from these emails, and to place the information into an

ERP system. After Script A has performed these tasks Script B was created to pass the data further along the process. Script B is responsible for taking the attached file out of the ERP server and to login this file into Company D's Oracle database. Then a SQL loader is used to translate and map the file's data based on customized standards created by Company D and their vendors. These customized standards allow them to exchange any data that is stored in their ERP database. A customize program then verifies if the data is the correct data needed for the ERP server and also to see if it is duplicate data. The data is then populates the correct tables located in the ERP server and made visible to its users.

Most of the information that Company D receives from their vendors by this process is shipment notice information. This information would include Bale #, Bale data, pounds, and shipment information for fiber raw material. Yarn raw material information would include Case #, number of packages, net weight, and shipment information. All of this information is kept segregated from each other by Vendor # and purchase order #.

**Sending Information**

Company D has set up a table inside their database that contains the email addresses of the customers that want their data sent by this process. This table was created so Script C can extract requested information for these selected customers from the Oracle database. After the customer has requested for Company D to send data by this process and their email information is put into the table the data follows the process shown in Figure 44.

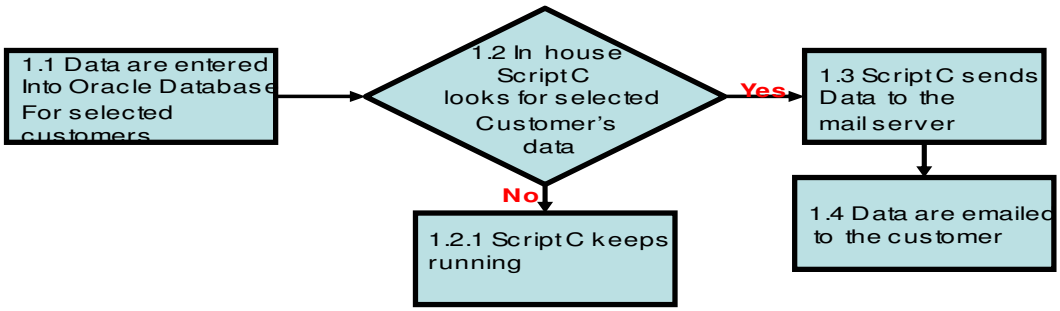


**Figure 44: Sending Process Flow Diagram**

This process is only made up of four total steps and begins when data are scanned or keyed into the database. Script C then looks for data that matches customer numbers in the email request table. This data are sent to the mail server by Script C and emailed to the customer. Packing slip data is the only information sent by this process because this is the only information Company D's customer requests. The data that is typically included in a packing slip is yards per roll of fabric, net weight of the shipment, fabric characteristics, the ship date, and the receive date. Over 50% of their customers are using this information to update their raw material inventory. Only one of Company D's customers is still using EDI while 12 to 15 have switch to their customized system.

## Barriers & Benefits

Implementing this customized system has generated benefits for Company D but they also had to face barriers during this time period. The main barrier from their customers

using this process to exchange B-2-B supply chain transactions is they have a standard process to handle this information. These customers do not want to spend the time to change their system since the VAN monthly and transaction charges are not large costs for them. They also do not want to spend the time it takes to adjust their system to handle this data format.

The benefits generated from this system have been responsible for 12 to 15 of Company D's customer adopt it. The major benefit of this system is it has no cost per transaction or per month since it has eliminated the use of a VAN. This benefit alone has created a great selling point for Company D to use when attracting new customers. Company D's system has also increased the accuracy of the data sent and received by them based they have rarely had a problem with its efficiency.

# 5 Summary, Conclusions, and Recommendations

## 5.1 Summary of Results

The purpose of this study was to define what business-to-business transactions are in the US textile manufacturing supply chain, determine how US textile manufacturers were using e-business initiatives in their supply chain, and what benefits and barriers they faced during the implementation for e-business technology. For this research, an open-ended questionnaire was composed to study the e-business supply chain environment for US textile manufacturers when dealing with B-2-B transaction. The questions were developed from secondary sources and were designed not only to understand this environment but to get real world examples in the form of case studies. These case studies investigated the cost and savings of implementing different e-business technologies to handle B-2-B supply chain transactions. Also, to understand what supply chain information generates the most benefits when a manufacturer shares it with their customers through the use of e-business.

The success of this study was created through the data that were collected from the interviews and the case studies. This strength of the information came from the experience of the individuals interviewed, their openness to share information, and the representation of individuals from different sectors of the textile manufacturing industry.

**RO1 Develop a definition for US textile manufacturing supply chain business-to-business transactions.**

In Phase I of this research a definition was created for US textile manufacturing supply chain B-2-B transactions. B-2-B supply chain e-business transactions are when two corporations exchange information pertaining to:

- Supply Chain Planning Activities
  - Advanced Planning/Scheduling
  - Demand Forecasting
  - Manufacturing Planning
  - Transportation Planning

- Supply Chain Execution Activities:
  - Order Planning
  - Production Replenishment
  - Distribution Management
  - Logistics

over an electronic network that is integrated with both corporations' internal enterprise system.

Table 29 shows the collection of transactions found during Phase I & II. This table has three sections; DAMA project transactions, transactions needed to conduct CPFR, and the transactions collected during Phase II of this research. All of the transactions are in EDI format based on ANSI X12 standards. The companies that were interviewed during Phase II did not have the capabilities to support eight of the transactions the DAMA project considered to be used in a traditional textile supply chain. However the US textile manufacturers interviewed in Phase II did have the B-2-B transaction capabilities to implement CPFR into their supply chain with the exception of two transactions. These two transaction that were not found in use by the US textile manufacturers during Phase II were Promotional Announcements (889) and Inventory Adjustments (852).

**Table 29: B-2-B Transactions Used by US Textile Manufacturers**

| EDI Transaction (ANSI X12 Standard) | DAMA | CPFR | Phase II |
|---|---|---|---|
| Promotion Announcement (889) | x | x | |
| Order Status Report (870) | x | | |
| Invoice (810) | x | | x |
| Response to Request for Quotation (843) | x | | |
| Ship Notice/Manifest (856) | x | x | x |
| PO Confirmation (855) | x | | x |
| Defective Material Adjustment (812) | x | | |
| Purchase Order (850) | x | x | x |
| Planning Schedule w/ Release Capability (830) | x | x | x |
| PO Change (860) | x | | |
| Request for Quotation (840) | x | | |
| Inventory Adjustments (852) | x | x | |
| Shipping Schedule (862) | | | x |
| Text Message (864) | | | x |
| Price/Sales Catalog (832) | x | | |

**Sources:** TC$^2$. (2000). DAMA model for collaboration. Retrieved October 20, 2005, from TC$^2$ website http://dama.tc2.com/, Voluntary Interindustry Commerce Standards Association, (2004). CPFR: an overview. Retrieved October 20, 2005, from VICS web site http://www.cpfr.org.

**RO2. Identify if e-business technologies are being used in the current US textile manufacturing supply chain practices that deal with business-to-business transactions.**

The results from the analysis of the 2003 US Census Annual Manufacturing Surveys data that were collected in Phase I of this research did prove US textile manufacturers were using e-business technology to exchange B-2-B transactions. These results confirmed that 14.8% of the value of shipments for US textile manufacturers was exchanged by B-2-B e-business technology.

The Phase II results of the open ended interviews then drill down this objective further in what kind of B-2-B technology is in use, and the results can be seen in Figure 45. The Phase II data shows that email, phone, and fax are the main processes used to exchange B-2-B supply chain data in this industry. However 75% of the respondents were using some type of e-business technology to exchange B-2-B supply chain transactions. The companies

that did not have any e-business technology tools implemented were smaller companies interviewed.

Based on the 12 interviews, 75% of them had some sort of EDI technology implemented into their business processes to exchange B-2-B supply chain transactions. The main EDI technology being utilized is VAN based on the fact that 58.3% of the companies were using this technology which is explained in detail in Case Study 1. The two other EDI technologies used were 3rd party and a customized process. The 3rd party process is when a company sends their B-2-B supply chain information in their original format to a 3rd party that translates it into an EDI file.

In addition to using EDI technology, US textile manufacturers are using other e-business tools to share their supply chain transactions. From the Phase II analysis, 33% of the companies are using extranet technology to exchange their B-2-B supply chain transactions. An example of extranet use is when a company secures an area of their public website or an extension of their intranet which allows customers and suppliers to see their own supply chain information (Scottish Enterprise, 2004a). Another major tool being used by this industry is Cotton Inc. Engineered Fiber Selection (EFS) software. This tool was only used by yarn manufacturers, and this process is described in Vendor Interview 1 in detail. Other tools being used to exchange B-2-B supply chain transactions were Web Interfaces, File Transfer Protocol (FTP), and e-business modules.

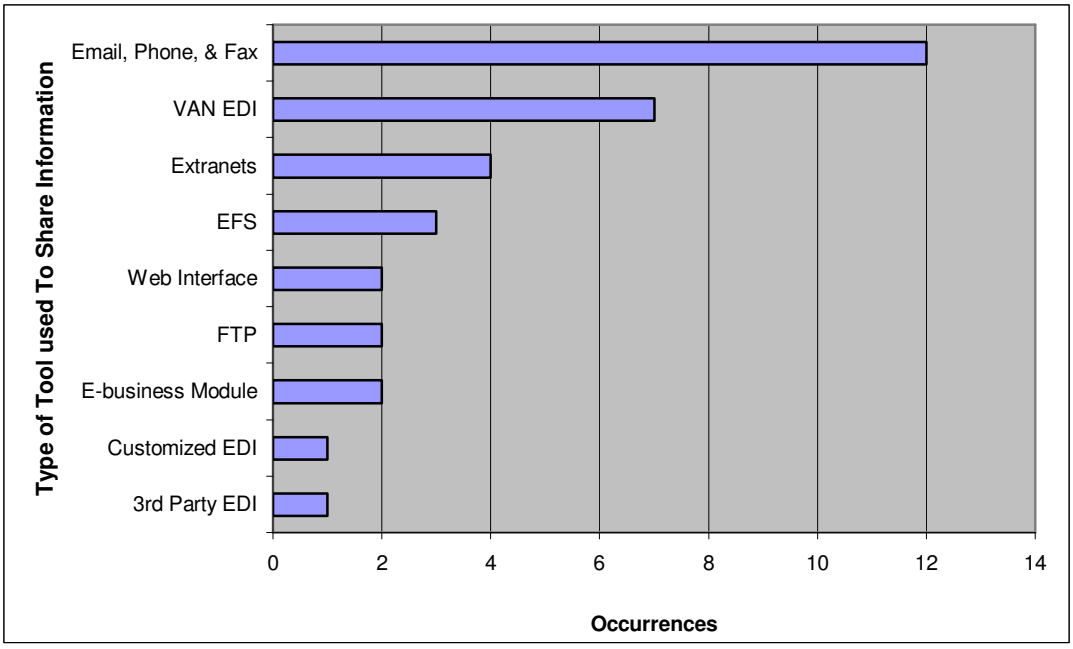


**Figure 45: E-business Technologies used by US Textile Manufacturers**

**RO3. Understand what type of data companies are exchanging with each other within the US textile manufacturing supply chain when using business-to-business technology.**

The information exchanged can be correlated back to the kind of transactions US textile manufactures are utilizing. In the DAMA project, the transactions they used in their "As-Is" model are the information they considered to be of high importance for the supply chain to share. The CPFR initiative has standard transactions needed to perform its duties, but it also has other information needed to complete its process.

The DAMA textile "As-Is" supply chain requires the manufacturers to share order management information. This information would include transactions such as 870, 810, 843, 855, 850, and 860. The model also includes inventory information to be shared such as 812, 856, and 852. Logistics and Sales information is exchanged when 856, 840, and 832 transactions occur. However the CPFR model also encourages the manufacturers to share

business plans, capacity, and replenishments plans to become highly integrated with their supply chain partners closer to the end customer.

The analysis of the data collected in Phase II of this study shows that shipment notice information is the most common information exchanged and is shown in Figure 46. Of the 12 interviews, 66% of the interviewees exchanged shipment notice information with their supply chain partners. Invoices and inventory information were exchanged the second most with 33% of the respondents. The remaining order management information exchanged is PO, PO acknowledgments, and order history. Planning information is also exchanged in the form of production and schedule planning with release capabilities. Shipping or logistics information is also exchanged by e-business technologies in the form of shipping schedules and the manifest of the products on the shipments. Also, 25% of these respondents did not share any information based on the fact that they do not have e-business capabilities.

Cotton bale information was also shared between yarn manufacturers and the cotton merchants through the use of the EFS system. This information allowed the yarn manufacturers to manage their inventory. Also it allowed them to track the shipments received per cotton contract.

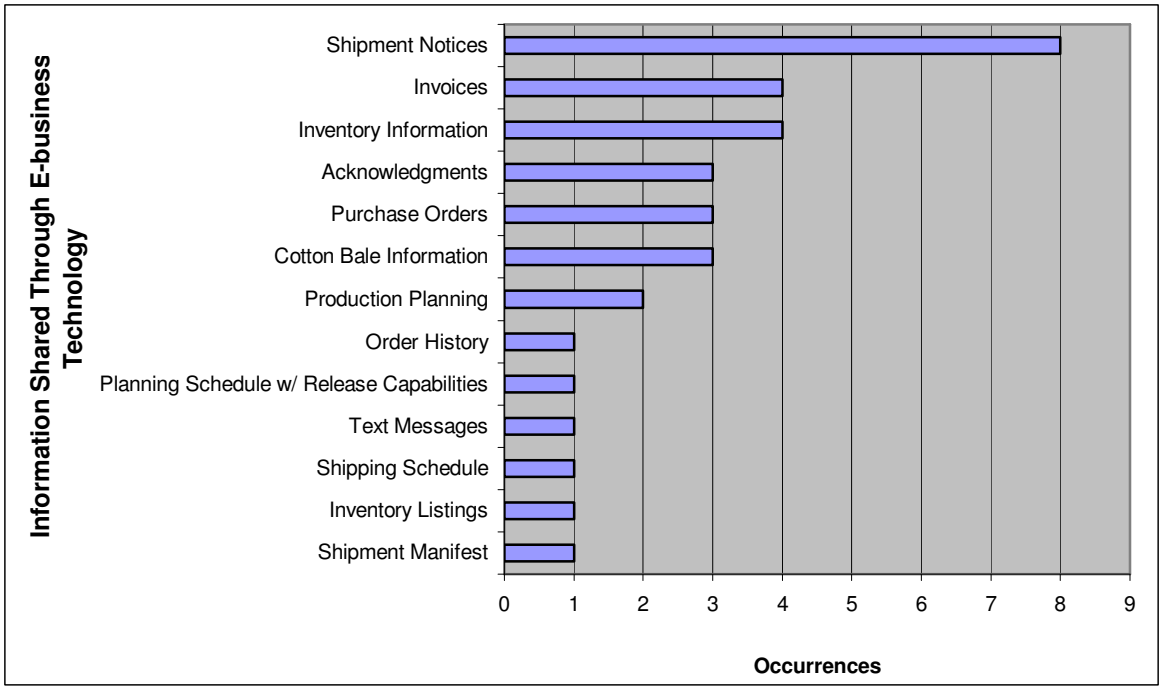


**Figure 46: B-2-B Supply Chain Information Shared by E-business Technology**

**RO4. Determine how the data are being used by US textile manufacturers after receiving it.**

The major use for exchanging this information was raw material inventory. There were 50% of the respondents using the information exchanged to perform this task as shown in Figure 47. The information sent by shipment notices like the example in Case Study 1 is how the information exchanged by e-business technology is used for managing a company's raw material. Of the 12 respondents, 41% were not using the data being exchanged. The respondents that were not using this information were the three companies that did not have any e-business technology implemented into their supply chain and two other companies that did not want to change their business processes. The reason why these two companies have e-business implemented is due to customer requests.

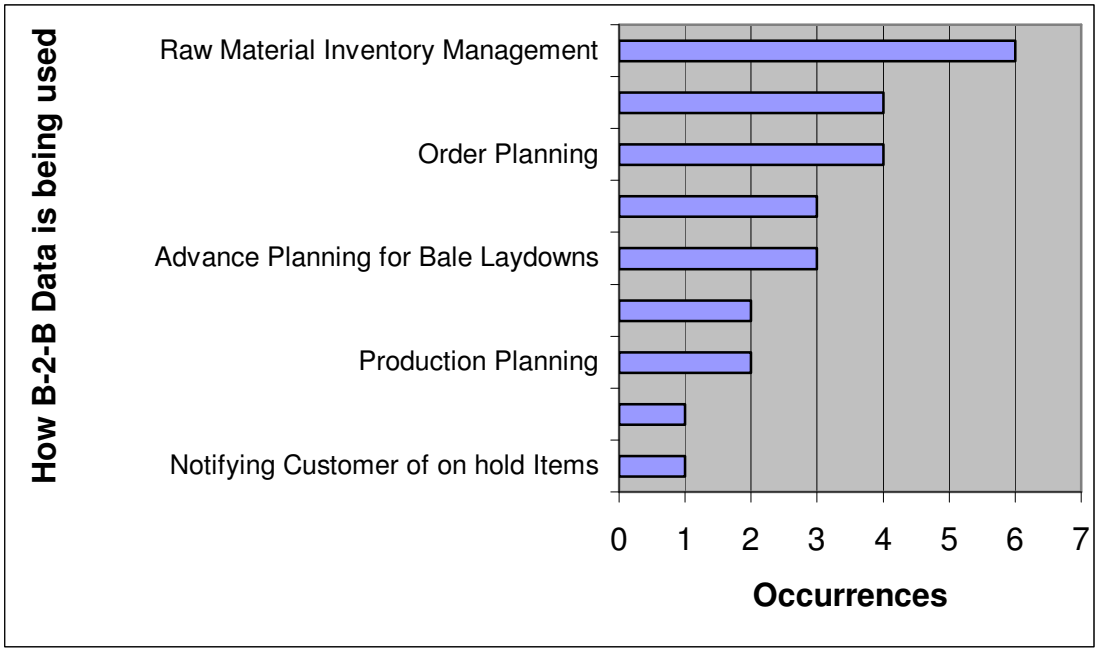


**Figure 47: How Supply Chain Data is being used**

This data is also being used to manage finished goods inventory. There were 33% of the respondents that used the B-2-B data to manage their finished goods inventory. Order planning is another process that is reliant on the information exchanged. Companies that performed order planning used invoice and purchase order transactions and also have the capability to make order history visible to their customers.

The EFS data that was exchanged between the cotton merchants and yarn manufacturers have allowed them to change their way of managing their inventory. Yarn manufacturers that have EFS capabilities now manage their yarn inventory by HVI data that is exchanged and analyzed by the EFS system. This system has allowed yarn manufacturers to plan production by single bale laydowns. Since they have visibility of the cotton bales in the merchant's warehouse yarn manufacturers can select bales to be direct ship to their plants for laydowns planned for that week's production. The e-business information shared among

US textile manufacturers is also used for communicating with customers, production planning, contract management, and notifying customers of inventory that is on hold.

**RO5. Determine how often these companies are exchanging this information.**

Out of the 12 interviews 75% of them are exchanging information with a batch process as shown in Figure 48. The different systems' batch times range from 15 minutes to once a day. There are 25% of the companies that do not have an e-business system setup so they do not have a timing process setup. Only one company has a real time system setup, and it is used for sending purchase order acknowledgements.

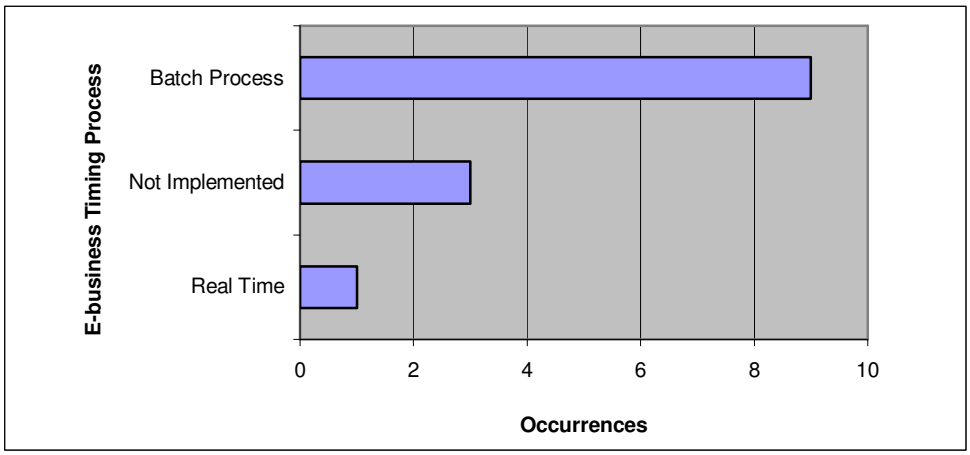


**Figure 48: How often the Information is Exchanged**

**RO6. Determine the barriers that are hindering the use of business-to-business technology in the US textile manufacturing supply chain.**

The top barrier for implementing B-2-B technology was the lack of IT staff with 58% of the occurrences in this study. The barriers do not mean the company that answered the question in this manner is the cause. It means these are the barriers they faced due to their trading partners responsibility or their own responsibility. The analysis of the barriers conducted in this study is shown in Figure 49. The other barriers receiving two or more

votes were cost, no demand for this technology, lack of financial resources, technology is not reliable, high trading partner turnover, and the company is too small.

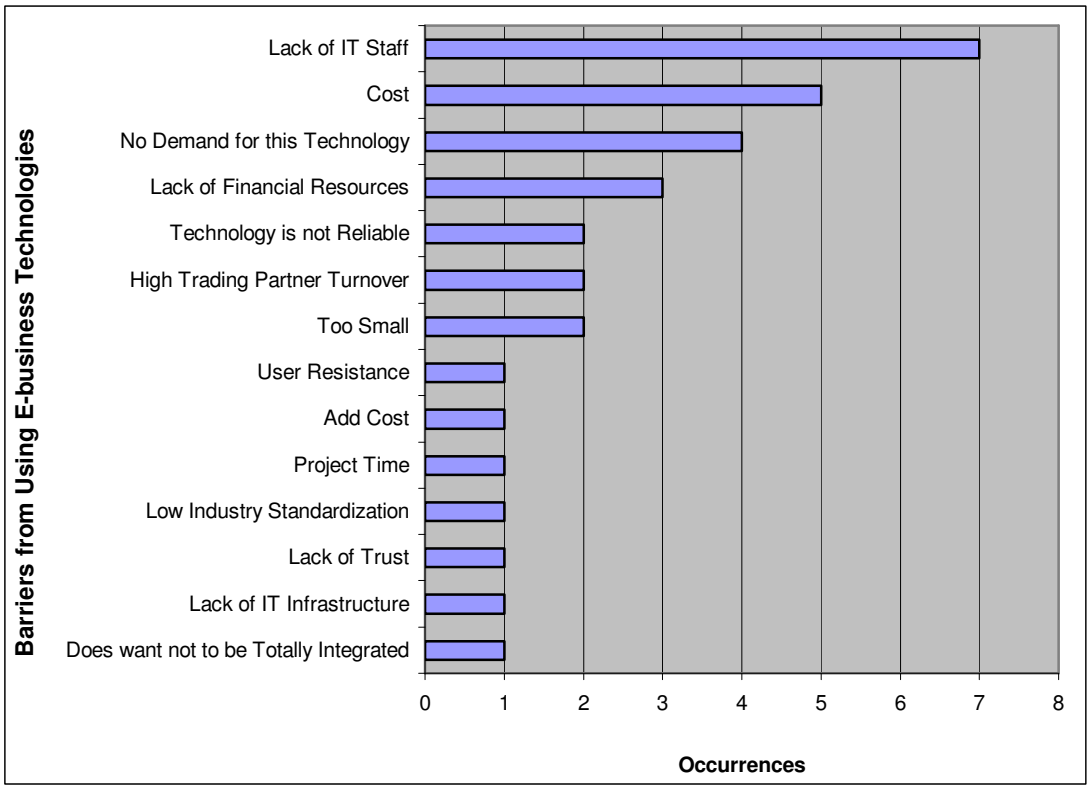


**Figure 49: E-business Barriers**

In Phase I of this study, an analysis of e-business barriers was compiled from four studies, but in the summary section, only one of the studies will be used, Cagle, 2006. Cagle is the only study that is being used because its sample is made up of textile manufacturers located in North Carolina and the other studies focused on multinational companies participating in different industries. The highest rank barrier that was common between the two studies was the lack of staff that is skilled to handle the implementation of e-business initiatives. The cost of e-business projects is another major concern among textile manufacturers. Time constraints and the lack of technical standards in this industry are the other two barriers found in both of these studies.

**RO7. Determine the benefits that influence US textile manufacturers to implement business-to-business technology into their supply chain strategy.**

The top benefit from implementing B-2-B technology into supply chain activities was the increase in data accuracy with 58% of the occurrences in this study. The analysis of the benefits found in this study is shown in Figure 50. Transaction cost reduction was ranked the second highest benefit found in this study. An example of transaction cost reduction is explained in greater detail in Case Study 1. Decrease in time spent on non value added tasks and improved customer satisfaction levels received 33% of the occurrences in this study. Two benefits that were considered of high importance were the increased visibility of information, and that e-business did not generate any benefits. Two of the companies that felt e-business did not generate any benefits did not have any e-business technologies implemented, and the other one implemented it due to a customer request. This same company also does not use any of the information exchanged with their customer in their business processes. The rest of the benefits had two or fewer occurrences.

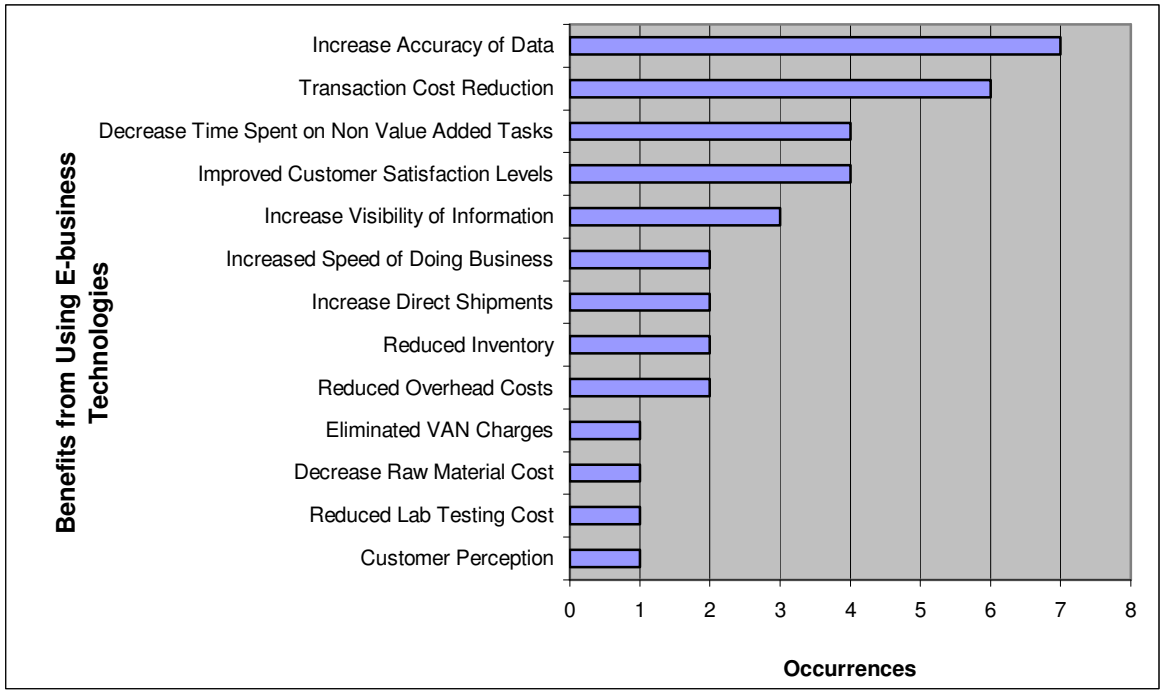


**Figure 50: E-business Benefits**

None of the respondents had any specific financial analysis to prove these benefits like the studies analyzed in Phase I. Phase I included financial benefits collected from the Canadian E-business Initiative, 2003, GCI, 202, and Lee, 2001. This lack of specific e-business benefits measured in Phase II was because the respondents did not have processes in place to measure their e-business performance.

**RO8. Develop strategies that US textile manufacturers can follow to implement e-business in respect to supply chain management.**

The top factor why these companies implemented e-business technology was based on a customer's request as shown in Figure 51. The second highest factor was the companies did not implement this technology, and again, this was based on the lack of demand for this

technology. Other factors that were found during this research were cost savings, improved data accuracy, increased flexibility, and to develop a competitive advantage.

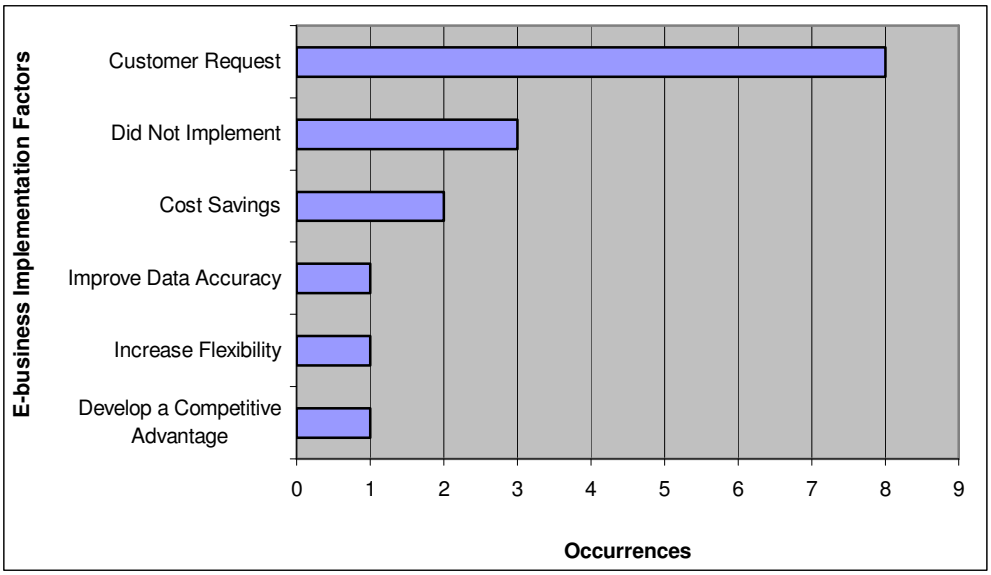


**Figure 51: E-business Implementation Factors**

The cases conducted in this research analyzed many options companies could implement to handle their B-2-B supply chain transactions. Case Study 1 analyzed the transaction cost and additional monthly cost for receiving and sending advance shipment notification by a manual, VAN EDI, and AS2 process. Based on this analysis, Company A implemented VAN EDI to eliminate the labor costs included in the manual process. The AS2 process now can eliminate the VAN charges in the EDI process, so the only cost accrued per transaction is the labor that cannot be automated. However in Case Study 3, Company D has implemented two scripts for no additional costs to eliminate VAN charges like AS2. Company D does not have any payback period because there were no implementation costs involved to create the same savings Company A will collect from the AS2 software.

Phase I had an E-business justification section where it described the financial methods companies follow to implement e-business projects. In the secondary sources, it

stated that 63% (Optimize Magazine, 2002), 67% (Cummings, 2001), and 66.6% (Lesjak, 2005) did not use any formal method to measure the e-business project's return on investment. The primary data collected during Phase II had only one company that performed a cost analysis for the e-business project. The analysis consisted of comparing the implementation cost of their system if it was done in house to the quote they received from a consultant.

## 5.2 Conclusions

1. Based on this sample, US textile manufacturers are using e-business technologies to exchange B-2-B documents, but they are not using them to integrate their supply chain partners with their company. US textile manufacturers want this technology to improve the accuracy of their B-2-B supply chain transactions and to make the information provided by these transactions easily available to key decision makers.
2. The lack of integration is because the manufacturers are not receiving information from their supply chain partners closer to the end customer.
3. Another factor for this lack of integration is that smaller manufacturers are less likely to have any e-business technologies implemented. The e-business project's cost and their lack of IT staff are the main barriers for implementing B-2-B technology into their supply chain.
4. US textile manufacturers also do not implement e-business technology because they do not see a demand from their trading partners for it.
5. Email, phone, and fax are still the main processes being used by US textile manufacturers to share B-2-B transactions in their supply chain.

6. The US textile manufacturers that have implemented e-business technology are utilizing VAN EDI with ANSI X12 standards.
7. The larger manufacturers are providing more than VAN EDI to their supply chain partners to reduce transaction cost. These companies are offering these options to make their supply chain partner's information visible and downloadable by e-business modules and extranet technology.
8. Advance Shipment Notifications is the main transaction that US textile manufacturers are exchanging with each other and which is used to manage their raw material inventory.
9. US yarn manufacturer have developed trust in the HVI data provided by Cotton Inc. EFS system. This increased trust has allowed them to use this system to decrease raw material inventory cost and transportation cost. This cost reduction is from the cotton merchants direct shipping selected bales to the yarn manufacturing locations based on HVI data.
10. The main factor that US textile manufacturers are implementing e-business projects is customer requests.
11. Before companies are implementing these projects, they are not using formal ROI methods to justify them.
12. The implementation of VAN EDI for receiving advance shipment notices will reduce labor cost in transactions.
13. AS2 software packages and customized scripts can be created to eliminate VAN charges that are accrued during transactions and monthly services.

14. AS2 software implementation consist of three costs- software, programming, and maintenance fees. The maintenance fees are about 18% of the software cost and are charged once per year.
15. The payback period for implementing AS2 software is less than a year if a company already has a VAN EDI system in place.

## 5.3 Recommendations for Future Research

1. Future studies should focus on specific textile product's supply chains that are integrated using CPFR and compare their performance based on certain supply chain metrics to a traditional supply chain in that same product market.
2. Another study should focus on developing a low cost option for smaller US textile manufacturers that can be used to send and receive B-2-B transactions electronically with low IT staff involvement.
3. Future studies should focus on how e-business is utilized in US textile manufacturers' business processes. Business processes could include customer relationship management, financials, and operations.
4. Studies could also analyze how e-business and lean manufacturing strategies can be used to increase the economic competitiveness of US textile manufacturers.
5. Another study could focus on using e-business technology to eliminate the top supply chain costs in the US textile manufacturing industry.

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# APPENDICES

# Appendix A: Open Ended Questionnaire

NC STATE UNIVERSITY

## Open Ended Interviews for Improving the Competitiveness of US Textile Manufacturers with E-business Initiatives Related to Supply Chain.

**Date**

**Respondent(s) Information**
Name:
Title:
Company:
Phone Number:
Email:
Interview Technique:

**Company History**

**1. What type of data are companies exchanging with each other within your product's supply chain?**

a. How did you and your suppliers or customers deem this specific information important to share?

b. How many customers do you have? Do you consider that a large amount for US textile manufacturer?

c. How is the company exchanging this information?

d. How did you decide to use this specific means of communicating tool? (already used it with other companies, customer pressure, cost savings) *If not implemented why is this? (no cost savings, no customer pressure)*

**2. How is this data being used by manufacturing companies after receiving it?**

a. What benefits have you seen in your business after sharing this information within your supply chain?(reduce transaction costs, forecast accuracy, production efficiency, customer & supplier satisfaction)

b. Did you have to reengineer any of your business practices to use this data?

**3. How often are the companies exchanging this information?**

a. Did you use another method before and if so what are the differences between them?

**4. What are the opportunities companies are running into that are hindering the use of e-business in their supply chain strategies?**

a. Did your supply chain overcome these hurdles, and if so what process did you follow?

# Appendix B: EDI Bill

| Type of Service | Description | Fee ( US $) | Month 1 | Month 2 | Month 3 | Month 4 | Monthly Average |
|---|---|---|---|---|---|---|---|
| EDI Express Mailbox Fee, Per User #, Per Month | Mailbox | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Mark 3 supplement fee, Per user #, per month | User Number Fee | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 |
| Service Initiation Fee, one time | 1time fee for initiation | 300.00 | | | | | 0.00 |
| Session Fee, Per Session (Peak Hours) | Cost to connect to the VAN | .20/time | 6.80 | 7.20 | 6.20 | 6.20 | 6.60 |
| Session Fee, Per Session (Off-Peak Hours) | Cost to connect to the VAN | .18/time | 3.24 | 2.70 | 3.06 | 2.88 | 2.97 |
| Interchanges Sent (Peak Hours) | Envelopes Sent to Customers | 0.23 | 1.38 | | | | 0.35 |
| | Number of Interchanges Sent (peak) | | 6.00 | | | | 1.50 |
| KC (1000 Characters) (Peak Hours) | Characters in Envelope from ISA to IEA | 0.26 | 3.22 | | | | 0.81 |
| | Average KC per interchange sent (peak) | | 2.06 | | | | 0.52 |
| Interchanges Sent to Interconnect (Peak Hours) | Envelopes Sent to 3rd party Networks | 0.23 | 12.88 | 9.66 | 12.19 | 9.43 | 11.04 |
| | Number of Interchanges Sent to Interconnect (Peak Hours) | | 56.00 | 42.00 | 53.00 | 41.00 | 48.00 |
| KC (1000 Characters) (Peak Hours) | Characters in Envelope from ISA to IEA | 0.26 | 26.60 | 19.53 | 22.93 | 17.24 | 21.58 |
| | Average KC per Interchanges sent to Interconnect (Peak) | | 1.83 | 1.79 | 1.66 | 1.62 | 1.72 |
| Interchanges Received (Peak Hours) | Envelopes Received | 0.23 | 0.23 | 1.15 | 1.84 | 0.92 | 1.04 |
| | Number of Interchanges Received (Peak) | | 1.00 | 5.00 | 8.00 | 4.00 | 4.50 |
| KC (1000 Characters) (Peak Hours) | | 0.26 | 0.21 | 5.90 | 5.41 | 5.02 | 4.14 |
| | Average KC per Interchange Received (Peak) | | 0.81 | 4.54 | 2.60 | 4.83 | 3.19 |
| Interchanges Received (Off-Peak Hours) | Envelopes Received | 0.22 | 3.30 | 1.54 | 2.64 | 1.54 | 2.26 |
| | Number of Interchanges Received (Off Peak) | | 15.00 | 7.00 | 12.00 | 7.00 | 10.25 |
| KC (1000 Characters) (Off-Peak Hours) | Characters in Envelopes Per KC | 0.25 | 13.90 | 7.43 | 9.48 | 6.68 | 9.37 |
| | Average KC per Interchange Received (Off Peak) | | 3.71 | 0.08 | 0.11 | 0.10 | 1.00 |
| Interchanges Rec'd via Interconnect (Peak Hrs) | Envelopes received from 3rd party networks | 0.23 | 0.46 | 0.92 | 1.61 | 2.76 | 1.44 |
| | Number of Interchanges Received via Interconnect (Peak) | | 2.00 | 4.00 | 7.00 | 12.00 | 6.25 |
| KC (1000 Characters) (Peak Hours) | Characters in Envelopes From ISA to IEA | 0.26 | 1.66 | 2.21 | 6.81 | 9.36 | 5.01 |
| | Average KC per Interchange Received via Interconnect (Peak)) | | 3.19 | 2.13 | 3.74 | 3.00 | 3.01 |
| Interchanges Rec'd via Interconnect (Off-Peak Hrs) | Envelopes received from 3rd Party Service | 0.22 | 2.42 | 1.54 | 2.42 | 4.62 | 2.75 |
| | Number of Envelopes received from Interconnect (Off Peak) | | 11.00 | 7.00 | 11.00 | 21.00 | 12.50 |
| KC (1000 Characters (Off-Peak Hrs) | Characters in Envelopes From ISA to IEA | 0.25 | 8.05 | 6.45 | 7.93 | 15.05 | 9.37 |
| | Average KC per Interchange Received via Interconnect (Off Peak) | | 2.93 | 3.69 | 2.88 | 2.87 | 3.09 |
| Documents Sent | 856 sent | 0.25 | 0.25 | | | | 0.06 |
| | Number of 856 Sent | | 1.00 | | | | 0.25 |
| KC (1000 Characters) | Characters in Documents from ISA to IEA | 0.42 | 0.38 | | | | 0.10 |
| | Average KC per 856 Sent | | 0.90 | | | | 0.23 |
| Documents Sent to Interconnect | 856 sent to 3rd Party Networks | 0.25 | 10.75 | 5.75 | 4.50 | 10.25 | 7.81 |
| | Number of 856 Sent to Interconnect | | 43.00 | 23.00 | 18.00 | 41.00 | 31.25 |
| KC (1000 Characters) | Characters in Documents from ISA to IEA | 0.42 | 33.31 | 11.55 | 9.28 | 22.30 | 19.11 |
| | Average KC Per 856 Sent to Interconnect | | 1.84 | 1.20 | 1.23 | 1.30 | 1.39 |
| Documents Rec'd via interconnect | 856 received from 3rd Party Network | 0.25 | 1.25 | 5.50 | 7.50 | 7.75 | 5.50 |
| | 856 Received from Interconnect | | 5.00 | 22.00 | 30.00 | 31.00 | 22.00 |
| KC (1000 Characters) | Characters in Documents from ISA to IEA | 0.42 | 5.25 | 25.07 | 29.11 | 28.35 | 21.95 |
| | Average KC per 856 Received to Interconnect | | 2.50 | 2.71 | 2.31 | 2.18 | 2.43 |
| Dial out Service, Premium Adder Per KC | Each time GE automatically dial outs to client's private number | 0.17 | 23.43 | 26.33 | 19.58 | 22.39 | 22.93 |
| | Number of times dial out service is used | | 137.82 | 154.88 | 115.18 | 131.71 | 134.90 |
| Management Report, Print Format, Per Page | Print report | 0.45 | 28.35 | 22.95 | 22.95 | 22.95 | 24.30 |
| | Number of reports printed | | 63.00 | 51.00 | 51.00 | 51.00 | 54.00 |
| Document/Interchange Storage, Per KC, Per Day | Storage of Documents | 0.03 | 2.49 | 4.10 | 4.91 | 6.59 | 4.52 |
| | Number of Documents Stored | | 99.60 | 164.00 | 196.40 | 263.60 | 180.90 |
| 3rd Party Interconnect, Per Network | Connect to Trading Partners that are not GE Clients | 39.00 | 156.00 | 156.00 | 156.00 | 156.00 | 156.00 |
| | Number of Interconnect connections | | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| * KC is equal to 1000 characters | | | | | | | |
| ** Interchange- an Envelope that contains EDI Documents | | | | | | | |
| ***Interconnect- when the VAN provider must connect with a 3rd party network for transporting the EDI file | | | | | | | |
| ****Document- is an EDI transaction which cannot contain more than 1 type of file | | | | | | | |