ABSTRACT

CAGLE, CHRISTINE MICHELLE. *IMPROVING THE COMPETITIVENESS OF NORTH CAROLINA TEXTILE MANUFACTURERS WITH E-BUSINESS INITIATIVES. (Under the direction of Dr. George Hodge).*

The purpose of this research was to improve the decision making process of textile manufacturers by providing information on how the North Carolina textile manufacturing industry is using e-business. This study reveals what e-business initiatives North Carolina textile manufacturers are currently using, the initiatives that they are planning to invest in next, the benefits experienced, the challenges faced, and in what business areas they expect to see the greatest future benefits from e-business for the textile industry. It is important to note that the focus of this study is on business-to-business e-business in textile mills and does not include textile product mills or apparel manufacturers.

The methodology used in this study consisted of two phases. Phase I was an analysis of secondary sources. A database of textile manufacturing companies in North Carolina with a primary NAICS code of 313 was compiled. The resultant database was used to develop the sample for Phase II-A, the questionnaire. The questionnaire was developed by the researcher based on information collected from the literature review and the analysis of similar studies performed abroad.

Phase II of the study consisted of two parts. Phase II-A was the distribution and analysis of the questionnaire. The resulting response rate was 38.1%, with 117 total usable responses. Phase II-B utilized case study methodology and built on the results of the questionnaire to gain a more in-depth understanding of the subject. The sample for

the case studies consisted of 7 companies in North Carolina and 2 companies in South Carolina.

The results indicate a limited degree of implementation of e-business in the textile mill sector of the North Carolina textile industry. While websites were used by 67% of the survey respondents, few are using e-business to its full potential. Telephone, fax, and email still seem to be the prevalent methods of communication with business partners, especially for small and medium sized firms. A conceptual model was developed indicating the current and potential implementation of e-business in the textile industry.

IMPROVING THE COMPETITIVENESS OF NORTH CAROLINA TEXTILE MANUFACTURERS WITH E-BUSINESS INITIATIVES

by
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BIOGRAPHY

Christine Cagle was born in Harnett County on May 5, 1975. She grew up in Spout Springs, NC where her family still resides. She graduated from Western Harnett High School in Lillington, NC in 1993. She completed her Bachelor of Science in 1997 and her Masters of Science in 2000, both at North Carolina State University. Her Master of Science thesis focused on the development of business-to-consumer e-commerce in the apparel industry. After graduation, she worked for a start-up internet company aimed at the technical textiles industry and then for the North Carolina Department of Commerce in the International Trade Division. She entered the Ph.D. program in Textile Technology Management in 2003.

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CHAPTER I

INTRODUCTION

Since the introduction of the Internet and e-commerce in the 1990s, there has been a lot of publicity surrounding e-business and the impact that it will have on the way that companies carry out their business processes and how it will change the global economy as a whole. After the collapse of many of the internet start-up companies in 2001, there has been much less media hype surrounding the use of the Internet for business. There seems to have been a realization that e-business may not be the answer to all of a company's problems. However, it can be a great asset in the struggle to increase the efficiencies in daily business dealings and is primarily a new way of relating to customers and suppliers.

Despite the fact that e-commerce has faced some challenges since the crash of the dotcom's, this has not meant the end of companies looking to the Internet to increase their business or to decrease their expenses. As reported in the study "Electronic Business in the Textile, Clothing and Footwear Industries" (August 2004), "The point is no longer the minimization of direct production costs but more the minimization of the overall supply chain cost, including standardized and agreed mechanisms able to evaluate quality and timing performances" (p. 13). It is a mistake, however, for companies to expect huge benefits from simply implementing e-business without changing their organizational structure (Dignum, 2002). Companies must now decide, as with any new venture, which type of business model will best support their e-business efforts. According to the article, "Why Business Models Matter" by Joan Magretta (2002), "a

business model's great strength as a planning tool is that it focuses attention on how all the elements of the system fit into a working whole" (p. 90).

According to the US Department of Commerce's report "Digital Economy 2003" (2003), "the roughly 50% of US manufacturing establishments that have computer networks also have higher productivity than manufacturing establishments without networks" (p. v). Although much of the literature discusses various e-business models that are currently being used by businesses, there have not been studies to show where US textile manufacturing companies can get the best results from e-business. Will they receive the greatest benefits from online catalogs, information exchange, product development, or supply chain management, to name a few? To gather this type of information it is important to understand where the industry currently is in terms of their e-business solutions, where they want to be, and what can reasonably be achieved. There is currently no way for textile companies to easily discover the types of e-business solutions that are working in their industry sector. According to the US Department of Commerce's report "Digital Economy 2003", "America's businesses and workers have a special need today for sound economic information and analysis…we need good information to make well-informed business decisions and better economic choices…good decisions and a growing economy are particularly important now" (introduction letter).

Although much has been written about business-to-business and business-to-consumer e-commerce in the apparel industry, little research currently exists on the use of business-to-business e-business in textile manufacturing. E-business can offer great benefits in terms of information exchange and management of business across great

distances. This would seem to make e-business an ideal initiative for textile companies trying to compete in this new global economy. This is especially true with the completion of the process of trade liberalization started by the signing of the WTO agreement on Textile and Clothing. As of January 2005, quantitative restrictions in exporting to the EU, US, and Canada no longer exist and this has lead to an even greater increase in competitive pressure from low labor cost countries. But the textile industry is highly fragmented, made up of many small and medium sized firms, which are historically lagging behind other industries in terms of implementing new technologies.

Purpose of Research

The purpose of this research is to improve the decision making process of textile manufacturers by developing a model for evaluating e-business solutions. This study provides US textile manufacturing companies with an overview of e-business initiatives currently used by their peers and a source of information on where others in the industry expect to find the greatest benefits and challenges in terms of e-business initiatives.

A similar study of European textile companies conducted by the European Union (May 2004) stated that "the large demand for the various publications and statistics provided by the e-Business W@tch, and their exploitation by other research institutions, documents that there has clearly been a demand for sectoral e-business analysis" (p. 5). This statement concludes that there is an interest in e-business information in Europe. Europe is facing some of the same issues in their textile manufacturing industry and sees the use of e-business as a way to combat these issues, and specifically, the European Commission hopes to use information on current uses of e-business to increase the competitiveness of European enterprises ("Electronic Business in the Textile, Clothing

and Footwear Industries", May 2004). Therefore, better understanding the use of e-business by US textile manufactures could help the US textile manufacturing industry in the same way.

Research Objectives

The objectives of this research are to:

1. Identify e-business initiatives currently used by textile manufacturers.
2. Identify e-business initiatives being considered by textile manufacturers.
3. Identify benefits to the adoption of e-business initiatives.
4. Identify barriers to the adoption of e-business initiatives.
5. Determine which e-business initiatives textile manufacturers deem to be most important for achieving a more competitive strategy.
6. Develop a conceptual model of e-business for textile manufacturing.

US-owned textile manufacturing companies with headquarters located in North Carolina are the focus of this research. The industry sectors included in the study are textile manufacturing companies defined by the NAICS codes listen in Table 1.

Table 1: NAICS codes for relevant industry sectors

NAICS code	Textile Mill Description
313112	Yarn Texturing, Throwing, and Twisting
313210	Broadwoven Fabric
313222	Schiffli Machine Embroidery
313241	Weft Knit Fabric
313311	Broadwoven Fabric Finishing
313320	Fabric Coating
313111	Yarn Spinning
313113	Thread
313221	Narrow Fabric
313230	Nonwoven Fabric
313249	Other Knit Fabric and Lace
313312	Textile and Fabric Finishing (Except Broadwoven Fabric)

Source: U.S. Census Bureau (2004). Manufacturing and Mining: Numerical List of Manufactured and Mineral Products. April 2004. Available: http://www.census.gov/prod/ec02/02numlist/313.pdf [April 26, 2006].

Significance of Study

This study is significant for several reasons. First, there is no information currently available to textile manufacturers who are seeking to use e-business to increase their competitiveness in an industry that is becoming increasingly global and competitive. Second, textile companies need help finding ways to compete and e-business is one possible method that needs to be explored. European countries that have faced the same (and possibly greater) problems in terms of competitiveness due to high labor and manufacturing costs are already involved in studying the importance of e-business and US companies need to have this same type of information available to them. The lack of using and recognizing the role of e-business in increasing efficiencies internally and externally may be a risk factor for US textile manufacturers trying to compete in the global economy. According to the e-Business Market Watch (May 2004):

> "To face global competition companies will have to engage in a continuous process of innovation and modernization and deal with a

number of challenges. In terms of the process of innovation and modernization, the main issues are: product innovation, modernization of organization structure and the speed up of technologies. Main challenges to cope with will be: increasing competition and changes in the distribution system, evolution of international trade, evolution of markets and consumers" (p. 24).

E-business may help companies to cope with these challenges, specifically by modernizing the organizational structure.

Limitations of Study

1. A convenience sample was used for the case studies, and not a random sample of the entire population.
2. The study provides an exploratory view of the subject and does not provide in-depth analysis of the subject.
3. The sample may not be representative of the entire US since only companies in North Carolina were included in the research.
4. There is a possible refusal bias. "The possibility that respondents differ in their characteristics from those that refuse to participate. However, this effect cannot be avoided in any voluntary survey" ("ICT and Electronic Business in the Textile and Clothing Industry", July 2005).

This dissertation is divided into five chapters. Following the introduction, Chapter II is a review of the literature. It summarizes and categorizes the various e-business models discussed in the academic literature. Chapter III is the Methodology section. This chapter details the methods used in performing the research. The

Methodology is broken into two phases. Phase I describes how the secondary research was collected. Phase II describes the primary research that was collected in the form of a questionnaire and case studies. Chapter IV discusses the results collected during Phase I and Phase II of the research, and Chapter V finishes the paper with conclusions and recommendations for future research.

CHAPTER II

LITERATURE REVIEW

This chapter categorizes and discusses the different types of business-to-business e-business models discussed in the academic literature and shows how these business models are being implemented within the textile industry.

The literature review is divided into four parts. Part I gives an overview and some important definitions associated with business-to-business e-business and discusses some characteristics that are unique to doing business on the Internet. Risks and benefits associated with doing business online are also discussed. Part II analyzes the different types of e-business models seen in the academic literature. Based on the analysis of the literature, a taxonomy of e-business models was developed. This new classification system organized e-business models into the following categories:

1. sourcing models,
2. ownership models,
3. service-based models,
4. customer relationship management models,
5. supply chain models,
6. interaction models and
7. revenue models.

Part III reviews how these e-business models are currently being used within the textile industry. A preliminary analysis of 79 textile manufacturing companies was conducted to identify the applications of e-business within the industry. Part IV is a summary of the literature review.

Part I: Background

Part I of the literature review defines the terms associated with business-to-business e-business models, characteristics and attributes associated with using the Internet to do business, and the risks and benefits companies can face when making the decision to go online. First, the definition of B2B e-business models will be discussed.

Definition of B2B e-Business Models

Business-to-business (B2B) in general is defined as commercial business between trading partners (Gottschalk & Abrahamsen, 2002). An electronic market is defined as an information system that links together buyers and sellers to exchange information, products, services and payments through computers and networks (Gottschalk & Abrahamsen, 2002). Business-to-business e-commerce is a combination of these two definitions where the information system is generally the Internet, but may also be other proprietary systems such as a LAN (local area network), a VAN (value added network), or an EDI (electronic data interchange) network. The benefits of using the Internet to do business include:

- The potential to lower costs by selecting suppliers, establishing prices, ordering goods, and paying bills electronically
- Transactions can be completed regardless of location
- Buyers and sellers can be matched in a digital forum for pre-sale, sales transactions, and post-sale activities (Gottschalk & Abrahamsen, 2002).

It is important to realize that business models and strategy are not the same thing. Business models describe how the pieces of a business fit together, but do not take into account competition. A competitive strategy explains how a company will do better than

their rivals by being different. Businesses, online or not, must have both in order to be successful (Magretta, 2002). According to the article "Process Models and Business Models – A Unified Framework", there are two types of models in e-Commerce, a business model and a process model. Business models define the 'what' in an e-commerce system and are concerned with value exchanges among business partners and the process model defines the 'how', focusing on the operational and procedural aspects needed to make the system work (Bergholtz, Jayaweera, & Wohed, 2002). The focus of this chapter will be on how business models add value to an e-commerce system. The next section will discuss some characteristics unique to the Internet that need to be understood when engaging in e-business.

Internet Characteristics

Some basic characteristics of the Internet must first be described in order to understand the impact that business-to-business e-business will have on an organization. First, the broadcasting model of the Internet is different from the traditional broadcasting model, of television or radio, for example. The Internet allows for a many-to-many communication model verses the traditional one-to-many model (Novak & Hoffman, 2001; Temkin, 2001). In other words, any user of the Internet can also be an information provider. Second, consumers interact with not only humans, but also with intelligent agents. An intelligent agent is defined as:

> "A software entity that carries out a set of operations on behalf of a user with some degree of independence or autonomy, and in so doing, employs knowledge or representation of the user's goals or desires".[1]

[1] Retrieved from http://www.semb.co.uk/reference/glossary.htm on September 16, 2004.

This second characteristic also leads to a third, consumer competence. It is important to address the skill level of the customers. The website should be user-friendly so that the company does not have to train customers on how to use the site. The Internet also allows for a wealth of information to the customer and an extraordinary level of choice. Companies must consider how to help customers make correct decisions with so many choices available.

Finally, the balance of power has shifted with the use of the Internet toward the consumer. With this shift, issues of online privacy and security must be addressed. This also brings into play the importance of trust, and the role of brand name becomes even more important online (Daly & Bruce , 2002; Mahadevan, 2000; Novak & Hoffman, 2001). This includes not only the brand of the product itself, but also the company distributing the product. Brand offers value to customers when purchasing online by lowering search costs, quality knowledge, and inspiring trust (Gallaugher, 2002). Some trust issues that customers may look for before doing business with a supplier online include: generalized reputation or perception of supplier or distributor, customer expectations for security, privacy and confidentiality, assurances provided by the supplier such as certifications or guarantees, and reports of other customers (Daughtrey, 2001). Additional factors that may influence a customer's additional transactions with a supplier online include: accuracy of order fulfillment, timeliness of order fulfillment, nature of any interactions with customer relations, resolution of any disputes, subsequent communications from supplier, and any communications from other suppliers with whom customer information was shared (Daughtrey, 2001).

In addition to the characteristics discussed above, according to an article in *Integrated Manufacturing Systems* by Peng (2002), "Internet technology is changing the way of product development, ranging form information gathering, product managing and commerce to product development and maintenance" (p. 319). It is important to understand how using e-business can change the entire organizational structure. Using the Internet to do business takes away many of the restraints that are present in traditional business. For example, the range of content on a website is anything that can be digitized, information is more easily accessed and readily available, and digital copies are essentially free (Novak & Hoffman, 2001).

These new attributes lead to new customer consequences. Customers can more easily compare prices and product offerings, there are lower search costs, and they have a wealth of information at their fingertips (Mahadevan, 2003). This is generally, however, more of an issue with business-to-consumer e-commerce, since most companies engaging in B2B e-commerce will not publish the prices of their products on their public website since they often offer different prices to different customers. These customer consequences can be used in favor or against the organization (Novak & Hoffman, 2001). The lower search costs and the ability to easily compare prices and product offerings can lead to more competition for the firm and the large amount of information available can be overwhelming to the customer, along with the possibility of a large amount of alternatives to consider. Companies can turn these consequences around, however, by providing customers with decision-making aids and having available on the website all of the information that a customer may need. They can also customize the website for individual customers so that they only see products and services that are of interest to

them, thus cutting down on the overload of information and alternatives. These characteristics associated with the doing business on the Internet have both risks and benefits to companies.

Risks Associated with B2B e-Business

In order to understand why a company would or would not decide to implement B2B e-business, some of the perceived risks and benefits should be discussed. Some of the prevailing reasons for not entering into the e-business arena are listed below:

- Could lead to uncontrolled growth
- Fear of alienating intermediaries
- Satisfaction with current business arrangements
- Concern about levels of understanding the technology
- Time and expense of the reengineering process
- Fear their products are not suited for the Internet (Power, 2002).

These are reasonable fears that need to be addressed, especially in small firms where the cost of implementing an e-business solution would have a huge impact on the business and the failure of such an endeavor could cause serious damage and could potentially drive the company out of business. Firms must also take into account the retaliatory power of existing intermediaries. It is important that they are able to avoid, or at least contain, channel conflict and thus the alienation of their existing business partners (Clemons & Aron, 2002; Daly & Bruce, 2002).

Companies thinking about investing in an e-business solution must also take into account if their suppliers and customers are ready for the transition. If the customers and suppliers will not participate, then there is not much point. There is also debate as to

whether the Internet enhances relationship marketing. On the one hand, with the use of the Internet, companies can custom tailor information about products and services to individual preferences, but on the other hand, there is the argument that the lack of human interaction will damage the customer relationship (Galbraith & Merrill, 2001).

The implemented e-commerce system must also be 100% error free. Unlike a salesperson working for the company who knows where the flaws in a system may be, an online shopper expects the information presented on the website to be completely accurate. One misunderstanding or mistake can ruin an important business relationship (Hallsby & Cain, 2001).

Benefits Associated with B2B e-Business

Once a company has taken into account all of the risks involved when committing to an e-business solution, they must also take into account the benefits that can be gained by going online. One of the main reasons that a company would opt to go online is for the potential cost reduction opportunity. There are potential cost reductions in transaction costs, error reduction, and reduced lead-time, which lead to lower costs of services and products and improved efficiency (lo Storto, 2002; Mahadevan, 2000; 2003). There is also the potential to manage inventory more efficiently, adjust more quickly to customer demand, get products to market faster, and cut down on the cost of paperwork (lo Storto, 2002). According to an article in *Managerial Finance* by Galbraith and Merrill (2001), "with the Internet a firm can offer a fully integrated, tightly linked system, with a searchable catalog, improved ordering and delivery options, back-office record keeping and billing, real-time inventory management, and constantly updated advertising and customer preference data gathering; often times at substantial cost

reduction" (p. 3). Manufacturing Execution Systems (MES) can be integrated with a company's Enterprise Resource Planning (ERP) system and their website so that the company's plant floor operations are linked directly to the company's website and customers can track orders on the plant floor (Bartholomew, 2001).

Another benefit to companies conducting business with the aid of the Internet is the ease of information collection and dissemination. Information is more easily accessed and readily available to customers who may be in different time zones (Novak & Hoffman, 2001). According to a survey conducted by the Norwegian Statistical office, companies involved in e-commerce wanted to achieve improved flexibility first, and gain new customers second (Gottschalk & Abrahamsen, 2002). Another huge advantage for companies conducting business through the Internet is the fact that interactions with customers can be easily monitored and logged. If this information is collected and used properly, it can provide a company with a wealth of marketing information (Dignum, 2002). The fact that the Internet is an open standard is also a great benefit (O'Grady & Chuang, 2001). The Internet is open and freely available since all that is needed is a computer, an Internet service provider and a web browser to use the Internet.

Companies can also use the Internet to differentiate their company from other similar companies. They can offer more customization, they can provide a lower price due to the cost savings that they attained by using the Internet to do business, and they can offer premium customer service (Osterwalder & Pigneur, 2002). It should be noted, however, that the savings associated with doing business online are not immediate and only come with time as the business becomes more efficient.

Companies seem to see the benefits of e-business overriding the risks. According to a report by NAPM/Forrester Research on e-Business, US organizations increased their participation in online marketplaces from 19.1 % in January 2001 to 22.7% in April 2002 (Gottschalk & Abrahamsen, 2002). Some of the attributes and services available to companies conducting business online will now be discussed.

Website Attributes and Services

Before discussing the various types of business models currently used on the Internet, some of the possible services available through the use of the Internet that can be incorporated into the e-business model will be discussed. Some of the most popular services offered by business-to-business websites are: information exchange, digital catalogs, online auctions, logistics services, supply chain planning, and design collaboration (Laseter & Capers, 2003). According to a survey conducted by *Strategy+Business*, information exchange, digital catalogs, and online auctions were the attributes most frequently integrated into the companies' websites, with respectively 65%, 63%, and 55% of the companies surveyed reported offering or planning to offer these services. Logistics services, supply chain planning and design collaboration were reported to be used or planning to be used by respectively 21%, 8%, and 4% of the companies surveyed (Laseter, Long, & Capers, 2001).

The easiest and most readily used function of the Internet is for information exchange. This is generally where most companies start with their Internet presence. Using a website as an information exchange costs relatively little and helps to build a sense of community (Laseter, Long, & Capers, 2001). Communication capability is increasing rapidly every year. There is now a three-fold increase in communication

capabilities per year. This increase in communication capabilities infers that there will be an ability to move enormous amounts of data around the globe at little cost (O'Grady & Chuang, 2001). The advantages of using information exchange to facilitate an online community with customers and suppliers are to create and maintain a closer relationship, to increase loyalty, and to help the company to react more quickly and accurately to customers demands (Dignum, 2002; Mahadevan, 2000). Feedback via the Internet can be very valuable to optimize products for important clients and to optimize production planning in relation to customer orders (Dignum, 2002). Some of the disadvantages of the online community are that the customer gets more power and can potentially get more good and bad information about products from each other. Also, the members of the online community may expect more and more up-to-date information about products and orders. (Dignum, 2002). This means that the company must be willing and able to keep up with the increased expectations of their customers and suppliers.

Another option that can be offered on a company's website is a digital catalog. With the use of a digital catalog, suppliers can gain access to a broader customer base without the incremental production and distribution costs of paper catalogs. Both suppliers and customers will save in transaction costs (Laseter, Long, & Capers, 2001). The use of a digital catalog is most easily used for standardized products, i.e., products where a customer can completely determine the product he wants to purchase by indicating a combination of values for all parameters (Dignum, 2002). Another benefit of the digital catalog is the ease of customization afforded by the Internet. A catalog can be customized for big customers so that they only see the products that are of interest to them (Dignum, 2002; Mahadevan, 2003). It can also be used to create a customer profile

that automatically shows the customer products that they have previously shown interest in and may also suggest alternatives or other products based on customers with similar profiles (Dignum, 2002; Mahadevan, 2003). Companies can also use digital catalogs internally as a way to integrate the products of all of their suppliers in order to offer a uniform format to all of the internal customers (Dignum, 2002). Ideally, the catalog would be integrated with the company's inventory and the customer could check the availability of the ordered items before they are actually ordered (Dignum, 2002). One of the potential difficulties of having an online catalog is that the catalog is available online 24 hours a day, seven days a week. This may often mean that organizational changes have to be made in order to capture orders and customer service requests that may come in any time of the day or week (Agarwal, 2001; Dignum, 2002).

Online auctions are another popular feature offered by B2B websites. Auctions allow for a one to many buying or selling of goods or services (Gottschalk & Abrahamsen, 2002). One reason for the popularity of this feature is the relatively low cost of the software. Online auction software can be purchased for as little as $50,000 (Laseter, Long, & Capers, 2001). This feature is good for buyers who can use this to their advantage to get an optimal price for goods, but many suppliers have experienced significant margin squeeze when forced to compete in this way (Laseter, Long, & Capers, 2001). Intermediaries use online auctions to reduce the information asymmetry that exists in normal business transactions. For example, if there are several potential suppliers competing for an industrial bid, if they are bidding in real time online, there is potential for there to be a reduction in the final bid (Mahadevan, 2000).

Collaborative product design, supply chain management and training are web-based tools that could potentially add enormously to a company's overall efficiency (Peng, 2002). According to Laseter, Long, & Capers(2001), supply chain management tools "help companies to share sales and production forecasts over the Internet" (p. 1). By fully integrating the supply chain via the Internet, companies can expect reduced supplier integration costs, minimized investment expenses, and optimized industry wide capacity (Temkin, 2001). Design collaboration helps manufactures to share product development tasks with their contractors via the Internet (Laseter, Long, & Capers, 2001). Integrated product development occurs when assemblers, customers, and suppliers are all involved in the product development process. This is facilitated by the Internet and can lead to improved designs, reduced product development times, and reduced costs. It can provide a mechanism through which design teams are able to exchange data quickly and accurately (O'Grady & Chuang, 2001).

One of the challenges associated with using the Internet to smooth the progress of the product development chain is the issue of dividing a design task into smaller, but independent, design objects so that their design can be performed separately and simultaneously by different parts of the product development chain so that all the separated objects are brought together into the assembled end product that meets the given design requirements (O'Grady & Chuang, 2001). Another product development challenge that can be addressed via e-commerce is collecting and compiling design requirements that may come from customer requirements or from the technical or economical requirements introduced by manufacturing (O'Grady & Chuang, 2001). E-commerce can also be used to convert complicated numerical results into a visual form

that can be more easily understood by the design team (O'Grady & Chuang, 2001). E-commerce can also allow for the inclusion of a wider variety of factors associated with the product, such as manufacturing and assembly restraints, taking into account factors that affect the integrity of product components in parallel development, and the greater ability to include customer requirement (O'Grady & Chuang, 2001). Logistics services involve "facilitating the physical flow of goods within a firm or between a firm and its suppliers and customers" (Laseter, Long, & Capers, 2001, p. 1). Providing this service is valuable to many customers, but managing the physical movement of goods is much more difficult than some of the other services that can be offered on the Internet. This may explain why this service is not used as often as some of the others (Laseter, Long, & Capers, 2001).

Some other attributes that a company can use to enhance the effectiveness of their website are affiliate programs, entertainment features, community features, customer control options, communication features, relevant news and information, search features, and incentive programs (Mahadevan, 2003; Novak & Hoffman, 2001). A company can use an affiliate program to increase traffic to their website. They offer affiliates who place links to their website a referral fee if a customer clicks on their link and purchases goods at their site. Entertainment, community and relevant news and information can be added to a site to keep customers coming back. The site can include community features that allow customers to share information about products. This can also generate more sales if reviews are good. Placing relevant news articles, providing an online magazine or providing product information on a site are other ways to keep customers coming back to the site regularly. Customer control, communication features and search features are

some ways to increase customer satisfaction at the website. One customer control feature is to allow customers to choose between finding the information they need on the web, chatting with web line advisors, or speaking to someone at a call center. Some communication features are using webcams to communicate with customers, chat features, or computer to phone calls. Business can even increase the effectiveness of their search feature by including not just location of the product but also recommendations for substitution or complementary products. The Internet market structure that the website falls into, to some extent, will dictate which attributes the website will offer.

Internet Market Structures

According to Mahadevan, all business on the Internet falls into one of three broad market structures: portals, market makers, and product/service providers. B2B portals primarily provide members of an industry with a sense of community by providing them with information about products, services, and general industry information. They are also used as focal points to channel traffic into the websites of product/service providers in the designated industry (Mahadevan, 2000). Market makers also offer customers a sense of community and industry information, but they differ from portals in that they participate in the facilitation of business transactions between the buyer and supplier. This market structure can provide an industry with cost reductions by reducing product search costs and transaction costs (Mahadevan, 2000). Product/service providers are suppliers that sell to their customers directly via the Internet (Mahadevan, 2000).

Once a company has weighed the pros and cons of taking their business online, they must then decide which direction would be best for their company in terms of

implementing an e-business model. Unfortunately, there is no unique, successful business model for companies that perform electronic business. Just as in traditional business, the model depends on the products and services that the company offers, the market structure, etc. (Dignum, 2002). It is also important to understand exactly what a business model is and what the company hopes to accomplish with the model. A good business model is essential to every successful organization whether it is a new venture or an established player (Magretta, 2002). Success online, as well as in traditional business, involves adding value to the firm as well as adding value to the customer (Novak & Hoffman, 2001). A good business model should tell who the customer is, what the customer values, how the business makes money, and how value is delivered to the customer at an appropriate cost (Magretta, 2002). All new business models are variations on the generic value chain underlying all businesses. They consist of two parts, activities associated with making something and activities associated with selling something. A new business model involves either the design of a new product or a process innovation, a better way of making, selling, or distributing an already proven product or service (Magretta, 2002).

In terms of business-to-business e-business models, the process innovation models are the way that companies will more commonly use the Internet. It is important for companies to understand that their business model does not have to be set in stone. According to the article, "Why Business Models Matter" in *Harvard Business Review* (2002), "business modeling is…the managerial equivalent of the scientific method – you start with a hypothesis, which you then test in action and revise when necessary" (p. 90). According to an eLab Position Paper from the Owen School of Management at

Vanderbilt University by Novak and Hoffman (2001), "for many firms…the greatest consequence of the Web for their business is that business models are seen as a challenge" (p. 8). In the following section, the e-business models discussed in the literature are discussed, and a taxonomy of these models is developed.

Part II: E-Business Models

The literature available on the subject of B2B e-business models varies from article to article. According to the article, "Examining E-Business Models: Applying a Holistic Approach in the Mobile Environment" by Vassilopoulou (2003), "…the business literature defines business models from different viewpoints, each focusing on different components. This leads to a fragmented and confusing picture regarding the shape and role of e-business models and the factors that distinguish successful business models" (p. 2). Most journal articles on the subject focus on a specific category of e-business model. This section categorizes the business models represented in the literature. Based on the e-business models found in literature, a taxonomy was developed with the following seven categories:

1. sourcing models,
2. ownership models,
3. service-based models,
4. customer relationship management models,
5. supply chain models
6. interaction models, and
7. revenue models.

It is important to note, however, that many companies will have e-business solutions that fall into more than one of these categories. Each of these areas will now be discussed.

Sourcing Models

The first category of B2B e-business models is the sourcing model. The type of sourcing that is typical for a particular product or industry will often influence the choice of e-business model adopted by the organization. An article in *Harvard Business Review* defines two sourcing methods that will influence the e-business model. The first is systematic sourcing, which occurs in industries where contracts are typically negotiated with qualified suppliers. The relationships are generally close, long-term relationships. The second type of sourcing is spot sourcing, which generally occurs with commodity or standardized products. The customer wants to fulfill an immediate need at the lowest possible cost (Kaplan & Sawhney, 2000). The type of product being sold also makes a difference in the sourcing type. Manufacturing inputs are raw materials and components that go directly into a product and are usually purchased from an industry-specific, or vertical, supplier or distributor (Kaplan & Sawhney, 2000). These products are generally sourced through the systematic sourcing method. The second type of product is an operating input. These are not parts of the finished products. Operating inputs consist of maintenance, repair, and operating goods. They are non-industry specific, or horizontal, suppliers (Kaplan & Sawhney, 2000). They are generally sourced through the spot sourcing method. E-business models that support the systematic sourcing method which are used in the textile industry will be the focus of this review.

In the article "E-Hubs: The New B2B Marketplaces", e-business models are categorized according to the type of product produced and the sourcing method. The four

types of e-business models generated from this matrix of goods verses sourcing options are:

- MRO hubs – non-industry specific markets that enable systematic sourcing of operating inputs (maintenance, repair, and operating goods),
- Yield managers – non-industry specific markets that enable spot sourcing of operating inputs,
- Exchanges – industry-specific markets that enable spot sourcing of manufacturing inputs, and
- Catalog hubs – industry-specific markets that enable systematic sourcing of manufacturing inputs (Kaplan & Sawhney, 2000).

These four types of models, which the article calls E-Hubs, are third party owned exchanges and can be either neutral or biased. Neutral e-Hubs provide a marketplace for buyers and sellers without favoring one over the other. They are equally attractive to buyers and sellers, but are more difficult to get started since buyers do not want to participate unless there are many sellers and vise versa. They must also overcome the sellers channel conflict. In other words, the sellers may be reluctant to participate because they are afraid of alienating their current distributors. Biased e-Hubs, which favor either the buyer or the seller, do not have this problem and thus can grow more quickly (Kaplan & Sawhney, 2000).

The main benefit of MRO hubs is the reduction in logistics and search costs when purchasing low-value operating goods with high transaction costs. They are owned by third parties that offer buyers access to consolidated catalogs from a wide array of suppliers. At first, the Internet was forecasted to get rid of intermediaries with customers

and suppliers dealing directly. This is still not common in B2B (Dignum, 2002). A MRO hub is actually just a new type of middleman that uses the Internet to bypass the traditional middleman, and are generally used to order operating supplies and do not have a direct impact on manufacturing.

Yield Managers focus on the selling of operations inputs. This type of business model usually works best with the buying and selling of operations inputs with high fixed costs that cannot be liquidated or acquired quickly (Kaplan & Sawhney, 2000). This type of website would be used by manufacturers to find new employees or to purchase manufacturing equipment.

Of the types of e-business models discussed in the article by Kaplan, catalog hubs and exchanges are the models that would most likely be used by textile companies to buy and sell their goods. According to this article, the Exchange model, "allows purchasing managers to smooth out the peaks and valleys in demand and supply by rapidly exchanging the commodities or near-commodities needed for production" (p. 99). With this type of e-business model, the third party provider of the exchange maintains relationships with the buyer and seller and manages these relationships so that the buyer and seller don't have to hash these out on their own. Logistics and fulfillment are conducted by third parties, and in many cases, the two parties do not even know with whom they are doing business. With the exchange model, companies can be both buyers and sellers. Therefore, any additional member to the exchange is a benefit to the entire market (Kaplan & Sawhney, 2000).

Catalog hubs are essentially the same as MRO hubs, except that the exchanges are industry specific. Catalog hubs bring together many suppliers at one website. The

websites can be either buyer focused or seller focused. The main benefit of this type of website is the reduction in transaction costs by providing the customer with one stop shopping. The customer can issue one purchase order for goods from many different suppliers. With this type of model, the roles of buyers and sellers are fixed. Therefore, the addition of additional sellers to this type of hub benefits only the buyers and the addition of additional buyers benefits only the seller (Kaplan & Sawhney, 2000).

Table 2: Matrix of Sourcing Models

	Non-Industry Specific	**Industry Specific**
Spot Sourcing	Yield Managers	Exchanges
Systematic Sourcing	MRO Hubs	Catalog Hubs

Source: Kaplan, S., & Sawhney, M. (2000). E-Hubs: The New B2B Marketplaces. Harvard *Business Review*, May-June, 97-103.

Ownership Models

The next category of e-business models is the ownership model. The basic e-market types can also be grouped in terms of the ownership of the website. The article, "Online Distribution: A Taxonomy of Channel Structures, Determinants of Outcome, And Determinants of Strategy" says that online channel structures can be owned by one or more manufacturers or primary producers individually or in cooperation, or they can be owned by a new entrant third party (Clemons & Aron, 2002). Similarly, according to the article "B2B Benchmark: The state of Electronic Exchanges" in *Strategy + Business*, e-commerce sites can be categorized as independent, consortia, and private networks,

depending on their ownership (Laseter, Long, & Capers, 2001). Independently owned websites are "pure-play dot-coms financed by venture capital" (p. 1), industry consortia owned websites are those backed by pooled funds, and private networks are websites that are created by individual companies (Laseter, Long, & Capers, 2001).

Independent B2B e-business models are seen as the riskiest venture since the end of the dot-com mania. Websites that are independently owned make up the majority of ownership models currently on the web, but are now risking extinction as few companies are finding clear ways to create value for the buyer or seller. They also have to deal with the greatest amount of competition and survive without the venture capital investments that were so plentiful prior to 2001 (Laseter, Long, & Capers, 2001). Independent models are the most at risk of extinction, due to the scarcity of venture capital and the lack of an already successful parent company, and must therefore look for ways to conserve cash while adding value to the customer. In order to do this they must find a niche market where they can develop a sustainable customer base whose business they can measurably benefit (Laseter, Long, & Capers, 2001).

Consortia-owned e-business models make up the smallest group of ownership models on the Internet today. Although this group may have the most potential impact on an industry, they must first overcome the problems created from conflicting agendas among founding companies (Laseter, Long, & Capers, 2001). The success of the consortium model depends on the creation of an integrated suite of services that becomes the industry standard. This is the best way to add value to the industry and encourage participation in the e-Marketplace. Second, there needs to be a small group of companies committed to the survival of the consortium. Too many owners could lead to the

downfall of the consortium if no companies have enough invested and looses the desire to keep the consortium alive (Laseter, Long, & Capers, 2001).

Privately owned e-business websites are those developed and used by a private company to source goods and sell goods to their customers (Laseter, Long, & Capers, 2001). These Internet ventures seek revenue growth and or efficiency rather than IPO riches (Laseter & Capers, 2003). This type of ownership model may consume resources that may otherwise support the consortia and independent models (Laseter, Long, & Capers, 2001). This type of model is probably more resilient than the other two since it does not depend entirely on new business to survive. Companies can just transfer their existing business to the Internet while cutting down on transaction costs and possibly attracting new customers.

The article "E-marketplace Survival Strategies" is a follow up to the study performed in the article "B2B Benchmark: The State of Electronic Exchanges" of 1,802 B2B sites in 2001. The results of this follow up study showed an average failure rate of the surveyed exchanges to be 45% upon re-examination in 2002. Of the consortium-backed models, 21% failed, while greater than 45% of the privately owned sites failed. The textiles industry e-Marketplaces had failure rates in excess of 60 percent. When categorized by service offering, the total procurement model had the highest failure rate and the full service and catalog models had the lowest failure rates (Laseter & Capers, 2003). Service-based models are discussed next.

Service-based Models

Another way to classify business-to-business e-business models is to group them according to the services that the site offers. This paper named this category service-

based models. These attributes and services include information exchange, digital catalogs, online auctions, logistics services, supply chain planning, and design collaboration. A description of each of these attributes is given in the introduction of this paper. The article "B2B Benchmark: The state of Electronic Exchanges" categorizes service-based models into total procurement models, catalog buying models, auction houses, collaboration facilitators, full service models, and specialty service models (Laseter, Long, & Capers, 2001).

Total procurement models include those companies that have websites featuring digital catalogs and online auctions. *Strategy+Business* found that 32% of the companies surveyed were using this type of B2B e-business model (Laseter, Long, & Capers, 2001). Catalog buying models feature only the digital catalogs as the main attribute of their website. A majority of privately owned websites use this model (Laseter, Long, & Capers, 2001).

Auction houses focus primarily on matching buyers and sellers through online auctions but do not offer digital catalogs. *Strategy+Business* found that 27% of the companies surveyed were using this type of B2B e-business model. Auctions have been around since the beginning of the Internet boom, and thus, have a lot of experience with doing business on the Internet. Auctions are a good way to make the price discovery process more efficient (Mahadevan, 2003), but with auction software becoming so inexpensive, these types of sites must find creative ways to add value to the customer to endure the competition (Laseter, Long, & Capers, 2001).

Collaboration facilitators focus their website primarily on supply chain planning and design collaboration to focus on aiding collaboration between buyers and sellers in a

way that adds value equally for the buyer and seller, thus attracting participation from both. This type of model is used by only 3% of the companies surveyed, but they seem to represent an emerging trend (Laseter, Long, & Capers, 2001). The current lack of use of this type of model may be due to the fact that the buyer and seller both must agree to use the model in order for it to be successful. This model will more than likely become prominent when large companies adopt this model and then force their suppliers and customers to also adopt the model

The full service model offers all of the services mentioned above on their website. This model accounts for only 5% of the companies surveyed and is generally owned by a consortium due to the large amount of revenue required to offer all of these services.

The specialty services model offers users information exchange and logistics services as its main features. Of the companies surveyed by *Strategy+Business*, 14% belonged to the specialty services model category. Most companies using this model provide information or other specialty services to a single industry (Laseter, Long, & Capers, 2001). Certain markets are characterized by fragmented supply chain leading to high vendor search costs, high information search costs, high product comparison costs, large market size and huge work flow costs. Logistics providers will add value to the buyers, sellers and intermediaries in these markets (Mahadevan, 2000). Table 3 illustrates the combination of services offered in each of the service-based models.

Table 3: Service-based Models

	Information Exchange	Digital Catalog	Online Auctions	Logistics Services	Supply Chain Planning	Design Collaboration
Total Procurement		X	X			
Auction Houses				X		
Collaboration Facilitators					X	X
Full Service Models	X	X	X		X	X
Specialty Services Model	X			X		

Source: Laseter, T., Long, B. and Capers, C. (2001). B2B Benchmark: The state of Electronic Exchanges. *Strategy+Business*. Available: http://news.com.com/2009-1017-275344.html [April 1, 2004].

Customer Relationship Management Models

The next category of e-business models is the customer relationship management model. The article by Frank Dignum, "E-commerce in production: Some Experiences", categorizes e-business models according to the services offered to the customer. The categories consist of customer and supplier management models and sales support and online catalog models.

The customer and supplier management model relies on using information collected on the customer to improve their experiences with the company. Companies can use the Internet to get information from their customers on their products and the transaction performance. This information, in turn, allows the company to better serve the customer and helps to build a closer relationship with the customer (Dignum, 2002). In B2B transactions, this type of model can be used to form closer relationships with important clients by optimizing products and production planning in relation to customer

orders (Dignum, 2002). This article identifies two different types of relationships that can be generated between the supplier and the customer based on this type of model. The first type of relationship involves forming tight relationships with a few big customers/suppliers. This type of relationship usually occurs in markets with only a few companies or a few very dominant companies. The second type of relationship is a looser relationship between customer and supplier. This type of relationship usually occurs in markets with standardized products and many global suppliers, where suppliers are chosen on an order-by-order basis. The Internet can help these companies to attract customers by making information about products easily available online and by making order processing easy with online ordering (Dignum, 2002).

Sales support and online catalog models use the Internet to sell their products to customers. Companies that sell products that can be described in a standardized format benefit the most from this type of model. This allows customers to accurately determine the product he wants by indicating a combination of values for all parameters. More customized products can also be sold via the Internet, but the selection process may not be so straightforward. Companies using this type of e-business model must decide how their catalog ordering will be supported. There are several options such as publishing a catalog online but taking orders via email, fax, or phone, taking orders through a value added network (VAN), or taking orders via the Internet. Companies may start out publishing their catalog on the web and not taking electronic orders and then may decide to take electronic orders via the Internet or through a VAN. The advantages of using a VAN to process orders are the security of data and the reliability of the network, but these networks are closed and would only be available for existing customers (Dignum,

2002). It is also important when developing an online catalog to determine what information to provide to the customer and how to set up the catalog so that it is easiest for the customer to find what they are looking for. Catalogs can also be customized for big customers so that they only see products that are of interest to them.

A paper by Agarwal emphasizes four parts of customer relationship management; Customer interactions, operational customer relationship management, analytical customer relationship management, and personalization. An efficient customer relationship e-business model will include all of these parts in order to differentiate itself, stay competitive, and maximize customer relations. Sales, marketing and customer service should be integrated between front and back office. Information obtained from customers should be analyzed in order to better serve the customer, and the web should facilitate greater communication between the customer and supplier (Agarwal, 2001).

Supply Chain Management Models

Supply chain management e-business models are not discussed as much as would be expected in the literature. Most e-business models spoke primarily about the management of parts of the supply chain and not the system as a whole. Supply chain management, however, is the ultimate in e-business models and may be difficult for many companies to obtain complete control of their supply chain via the Internet. The paper, “Defining the E-Business Model. A Tanning Technology White Paper” views three processes as instrumental in the development of an effective supply chain management model. These three processes are demand management, supply management, and inbound/outbound logistics (Agarwal, 2001).

Demand management involves managing the aspects of the company that involve meeting the demands of the company's customers. Supply management involves managing the upstream section of the supply chain, i.e. the companies suppliers. Inbound/outbound logistics involves coordinating the movement of goods along the supply chain. Agarwal (2001) views the goal for supply chain management e-business models to be to "create an end-to-end system that automates all the processes with suppliers, distribution partners and trading partners involved in ordering and paying for goods and services" (p. 7). Companies who are able to use the Internet to manage their supply chain will be able to communicate easily and share knowledge with their suppliers and customers, which will lead to strengthening and facilitating long-term relationships between these companies (Daly & Bruce, 2002). Also, because the Internet is an affordable option for all sizes of companies, it allows for a more complete link along the supply chain, encouraging greater collaboration and sharing of data between customers and suppliers (Daly & Bruce, 2002).

Interaction Models

Business-to-business e-business models can also be characterized by the way that the website facilitates interactions between buyers and sellers. The article, "E-commerce in Production: Some experiences", by Frank Dignum classified these models as websites, sales portals, procurement portals, and exchanges (Dignum, 2002). Websites connect suppliers and customers on a one to one basis. Sales Portals connect many suppliers with one customer and are organized by the procurement department of the customer. Only large companies who have enough buying power to force suppliers to trade through its portal usually do this. Companies using this type of model can standardize supply

information and have centralized control on procurement (Dignum, 2002). Procurement portals connect many customers to one supplier. Several customers can use this type of model to bundle their procurement and establish leverage against suppliers. Exchanges connect many suppliers with many customers and are usually not organized by the customer or the supplier, but by an independent third party (Dignum, 2002).

Similar to the eHubs discussed in the *Harvard Business Review* article, are what Gottschalk & Abrahamsen (2002) call Electronic Marketplaces. According to this article, an electronic marketplace is an "inter-organizational information system through which multiple buyers and sellers interact to accomplish one or more of the following market-making activities:

- Identifying potential trading partners;
- Selecting a specific partner; and
- Executing the transaction" (p. 325).

They then go on to say that an electronic market, or eMarket, is "an information system that links together buyers and sellers to exchange information, products, services, and payments" (p. 326). The authors of this article see these types of B2B exchanges as a type of electronic middleman. The benefits of an eMarket are the potential reduction of transaction costs such as selecting suppliers, establishing prices, ordering goods, and paying bills (Gottschalk & Abrahamsen, 2002). The types of eMarket models that they see emerging in the Norwegian market are procurement networks, service networks, supply networks and delivery networks.

Revenue Models

The paper " Profitability on the Web: Business Models and Revenue Streams" characterizes e-business models according to how they generate value for the customer and how they generate revenue for the company. They characterize the value models as brokerage models, content models, search models, incentive models, Freeware models, communication models, control models, outsourcing models, entertainment models, transaction models, affiliate models and community models (Novak & Hoffman, 2001). All of these have been discussed in the introduction of this paper as Internet attributes with the exception of the brokerage model. The article describes the brokerage model as a type of market-marker that brings together buyers and sellers and facilitates transactions (lo Storto, 2002). This type of model is third party owned and generates revenue by collecting a transaction fee from participants, selling advertising, charging subscriptions, or through sponsorship (Novak & Hoffman, 2001). The benefits of this type of model for buyers are that they are able to get direct access to broader supply sources, and procurement costs, intermediary transaction costs and markups are reduced (Novak & Hoffman, 2001). The benefits for sellers are direct access to broader markets, reduced transaction and selling costs, improved operating efficiencies, and reduced working capital costs through better inventory and receivables management (Novak & Hoffman, 2001). The article "Emerging B2B Ecommerce Relational Models in Italy: An Empirical Analysis" further categorized brokerage models as brokers, auctioneers, dealers, and exchanges. These categories differ from each other as to the way that the broker uses to fix the price (lo Storto, 2002).

Based on these attributes that add value to the customer, websites can generate revenue in a variety of ways. Some of the revenue models that are currently being used on the Internet are (Mahadevan, 2000; Novak & Hoffman, 2001):

- transaction fees
- referral fees
- license fees
- pay-per-performance
- advertising
- ransom model
- sale of customer data
- efficiency and effectiveness gains
- virtual real estate
- hosting fees
- subscription fees
- pay-per-view
- micropayment
- sponsorships
- margin on sale of goods/services
- offline customer response
- value-added services

For an explanation of each of these revenue models see the article "Profitability on the Web. Business Models and Revenue Streams" by Thomas P. Novak and Donna L. Hoffman (Novak & Hoffman, 2001). Websites may use one or many of these revenue models (Osterwalder & Pigneur, 2002).

Based on the previous review, an overall taxonomy of e-business models was developed as shown in Figure 1.

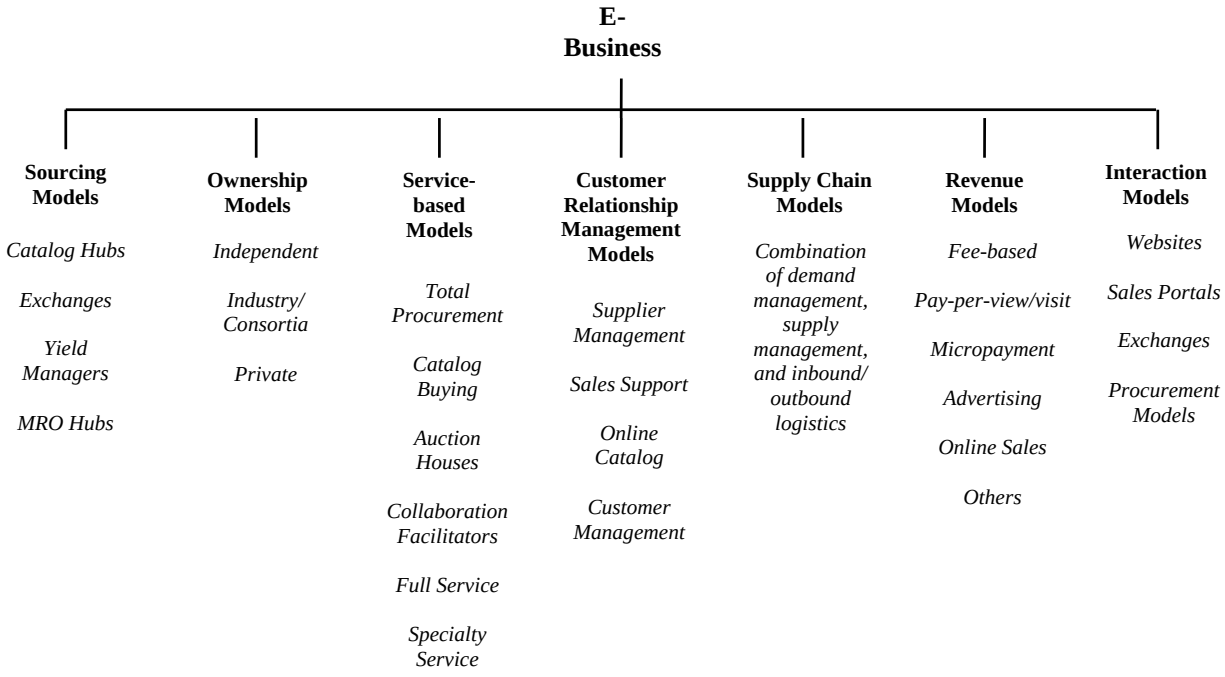

Figure 1: Taxonomy of E-business Models

Part III: E-business Models and Textiles

As in most other industries, the textiles industry uses a combination of the e-business models discussed earlier. This section discusses some of the textile companies whose e-business ventures have been discussed in the literature and relates them to the categories of e-business models discussed in Part II of this paper. In addition to the companies covered in the literature, the websites of companies listed as textile companies in Thomas Register were visited and categorized. First, the companies written about in the literature will be discussed.

BASF was one of the first movers to offer an e-commerce option to the textile industry, specifically carpet manufacturers and designers, in 2001. Their site offers sales, customer support, and technical support. The web application gives customers accurate and secure order placement and information 24 hours a day. It also offers order tracking

including manufacturing status, shipping status, shipping carrier and expected arrival date. Information services are also available on any BASF carpet product, including Material safety Data Sheets (Woodruff, 2001).

The BASF website fits into several of the e-business categories, including the Ownership Model, the Service-based Model, the Customer Relationship Management Model and the Interaction Model. All websites will fall into one of the categories discussed in the Ownership Model category. BASF's site is a privately owned model used to source and sell goods to customers. The site is also a catalog model, selling to customers through an online catalog. It is a customer relationship management model because it allows customers to gather information on goods and to track orders once they have purchased goods. The interaction that the site provides is between one supplier, BASF, and many of their customers.

Another textile company engaging in a privately owned e-commerce venture is Unifi. Founded in 1971, Unifi is one of the world's largest producers and processors of textured polyester and nylon yarn found in apparel, home furnishings, automotive fabrics, upholstery and legwear. Unifi owns and operates manufacturing facilities in seven countries on four continents. They also use a customer relationship management model, offering customers information on previous purchases, ability to check the inventory for an item, order online and get a delivery time and track samples (McCurry, 2000). Unifi's website also includes a service-based model, but unlike BASF, they use the total procurement model, which features both digital catalogs and online auctions. Unifi uses online auctions to sell their second quality yarn (McCurry, 2000).

E-marketplaces are probably the most plentiful type of business model currently available to textile companies. According to eMarket Services, 45 e-marketplaces are active in the Leather and Textile Sectors, with 23 focusing on textiles only, 9 on leather only, 9 focusing on both leather and textiles, and 4 on textile machinery (Gallacci & Atena, 2003). The ownership model is typically independent or consortia-owned and they work to facilitate transactions between many buyers and many suppliers. The service based models that are typically used are auction houses, catalog buying or a combination of the two, total procurement. The sourcing model is an exchange, industry-specific models that enable systematic sourcing of manufacturing inputs. Participants in Leather and Textiles e- marketplace transactions tend to be final resellers, representatives, producers of raw materials, final product manufacturers, and wholesalers (Gallacci & Atena, 2003). They also use a variety of revenue models, including but not limited to, transaction fees and membership fees (Gallacci & Atena, 2003).

Thomas Register has a listing of 165,000 U.S. and Canadian manufacturers that can be searched by product or service, company name, or brand name. As an initial indicator of how textile companies are using the Internet to do business, a search for "textiles" on Thomasregister.com was performed. Of the 590 listings in the chosen product headings relating to textile manufacturing, 94 websites were listed, but 9 sites were not found, three sites did not appear to be textile manufacturing sites, one site was located outside the US, and two sites were under construction. This left 79 websites under the product headings listed in Table 4. It is important to note that some companies fall under more than one product heading and that only websites listed in Thomas Register were included. Companies may have sites that are not listed or they may also

have additional sites than the ones surveyed, therefore, this is by no means a comprehensive listing and is just a sample of textile websites.

Table 4: Companies from Thomas Register related to Textile Manufacturing

Product Headings	Total companies listed	Number of companies with websites listed
Textiles	135	23
Textiles: Aluminized	3	1
Textile Slitting	5	4
Textile/Fabric Converters	67	15
Textiles: Electron	2	1
Textiles: Fiberglass	51	17
Textiles: Graphite	1	1
Textiles: High Temperature	51	21
Textiles: Hydrophilic	2	1
Textiles: Industrial	208	44
Textiles: Marine	34	12
Textiles: Medical	6	3
Textiles: Ceramic	25	14

The websites for the 79 companies were reviewed with respect to the taxonomy of e-business models described in Part II of this chapter. Of the 79 textile company websites reviewed, only 12 of them actually offered a feature that allowed for online sales as a revenue model. Of these 12, all were catalog buying service based models, only using catalogs and not auctions to sell their goods. Ten of the 12 companies that included a sourcing model for their website were classified as exchanges – industry-specific markets that enable spot sourcing of manufacturing inputs. All websites have some type of ownership model. Of the websites visited, all 79 websites were privately owned. Of the service based models used, all companies used information exchange to varying degrees. Most included some company information, contact information and product information. The customer relationship models include 64 online catalogs that give customers information on the products offered, 9 sales support models, one supplier

management model, and 10 customer management models. Most of the interaction models were procurement models, connecting many customers to one supplier. None of the websites visited were using supply chain management models. Figure 2 shows the breakdown of the models used by the sample of 79 textile websites visited.

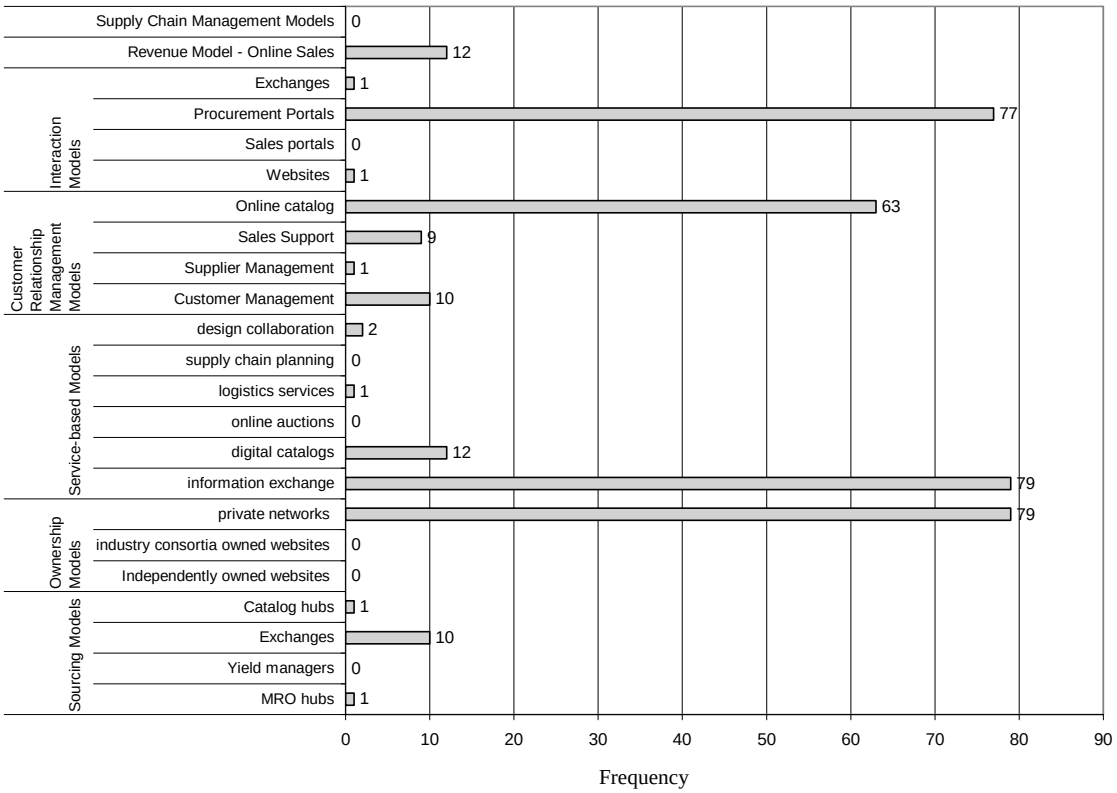

Figure 2: Textile Applications of E-Business

Product/Industry Factors that Effect Efficiency of Electronic Business

When describing the different types of business models, but the industry and the type of product being offered play a huge role in how successful an online venture will ultimately be. The article, "Making Sense of Emerging Market Structures in B2B E-Commerce", does an excellent job of classifying and describing these market and product attributes. The categories are degree of fragmentation, asset specificity, complexity of product description, and complexity of value assessment (Mahadevan, 2003). A highly

fragmented market is one in which there is no dominant group of buyers and sellers, but instead the industry is made up of many small, independent companies. If the market is very fragmented, for example, the Internet will be used entirely differently to do business than if the market is made up of a few big companies (Mahadevan, 2003). The textile industry is highly fragmented and participates in both vertically and horizontally integrated activities. For example, a textile company can be vertically integrated by engaging in such activities as Enterprise Resource Planning, Customer Relationship Management or Supplier Relationship Management. Textile companies also often engage in horizontally oriented activities by outsourcing part of their operation to a sub-contractor (Fischer, 2002). This may include outsourcing their human resources activities, for example.

Asset Specificity refers to the relationships that exist between trading partners. For example, a much tighter, well-defined relationship is needed when the transactions involve high-cost items, but are not so important when purchasing office supplies (Mahadevan, 2003).

Complexity of product description is just that. How difficult it is to describe the product to the customer so that they can understand the functional and technical specifications of the product or service (Mahadevan, 2003). Standardized products are generally thought of as more appropriate for Internet sales. In terms of the textile industry, this problem can be seen with the filtration industry. The sale of filtration products often requires expert support in choosing and servicing these complex industrial products. According to Hallsby and Cain (2001), they often require “detailed configuration, in-depth product and application knowledge and extensive after sale

support" (p. 74). This makes these products especially unsuitable for certain e-business models such as portals and online exchanges where a third party mediates the sale.

The complexity of value assessment "refers to the amount of information needed to estimate accurately the worth of an item and to either arrive at a price or select items offered at a price"(p. 97). For example it is easier to access the value of a new item than a used item (Mahadevan, 2003).

The European e-Business Market Watch lists several characteristics of the textile industry that cause barriers to the deployment of e-business in the textiles, clothing and leather industries in the EU that are also of concern for US textile manufacturing companies. These barriers include (European Commission, May 2004):

1. The small size of many firms and the very limited degree of computerization.
2. The conservative culture of the textile and clothing industry and the reluctance of many companies to pass on information and open up communication processes.
3. Many enterprises continue to rely on traditional methods of doing business even when they move toward closer co-operation with their partners.
4. "Diversity of Information Systems and diverse quality of access to ICT which may inhibit the process of integration" (p. 28).

Relevant Textile E-Business Studies

Previous research in e-business has focused primarily on EDI transactional processing and not on other initiatives, nor strategic benefits. Also, U.S. based textile manufacturers have not been the basis for investigations into e-business, although several studies have been conducted involving European and other foreign textile manufacturers.

This section will discuss some of these relevant studies that influenced this proposed research study of e-business in US textile manufacturing.

The most comprehensive study on e-business in the textile industry was performed by The European e-Business Market Watch and was financed by the European Commission. The sector report entitled, "Electronic Business in the Textile, Clothing and Footwear Industries" (May 2004) is part of an annual study funded by the European Commission to "monitor the growing maturity of electronic business across different sectors of the economy in the enlarged European Union and in the EEA countries" (p. 2). The goal of the e-Business Watch and, therefore, this study was defined by the eEurope 2002 and 2005 Action Plan which states; "to stimulate the use of the internet for accelerating e-commerce, acknowledging that electronic commerce is already developing dynamically in inter-business trading and that it is important for SMEs not to be left behind in the process" and also "to promote take-up of e-business with the aim of increasing the competitiveness of European enterprises and raising productivity and growth through investment in information and communication technologies (ICT), human resources (notably e-skills) and new business models" (p. 5). The study does not intend to cover any specific area of e-business in-depth, and instead opts for a "wide-angle" approach in which they "adopt a broader perspective and investigate more issues at the same time, which necessarily puts limits to the level of detail in which each single issue can be explored" (p. 6).

The study comprised of 10 sectors, including the textile, clothing and footwear industries. The textile industry sector resulted in two reports. The first contained quantitative results obtained by analyzing a survey that was conducted in two waves in

the spring and fall of 2003 to all 15 EU countries. The relevant results of this study for the textile, clothing and footwear industries are as follows (European Commission, May 2004):

- The use of ICT infrastructure in the textile, clothing and footwear industries is well below average, with only 74% of enterprises using computers compared to the average of all sectors equaling 89%.
- Access to the Internet and the use of email is limited to 58% and 48%, respectively, of the enterprises surveyed, in contrast to 76% and 68%, respectively, of the average of all sectors surveyed.
- Only 59% of the companies surveyed in this sector offered employees support in acquiring IT and networking skills development, compared to the all sector average of 77%.
- 12 % of enterprises outsource their ICT activities.
- 7 % of enterprises use online technologies to share documents internally or for collaborative work, 1 % to automate travel reimbursement, 3% to track working hours/production time, and 3% to support human resources management.
- 14% of enterprises make online purchases compared to 31% in the all sector average.
- The largest share of online purchasing is carried out through the supplier's website.
- Only 23% of enterprises use online technologies to exchange documents with suppliers, 17% with customers.

- 5% have an ICT system that is integrated with the supplier for placing orders, and only 1% use a supply chain management system.
- Only 22% of enterprises have an online presence, with only 3% selling goods online.
- 1% of enterprises use Customer Relationship Management software application.
- 10% of enterprises use online technologies (other than e-mail) for collaborative product design, 5% for collaborative demand forecast, 5% for capacity/inventory management, and 3% for contract negotiation.

The second part of the study (European Commission, August 2004) is qualitative in nature and "analyses in more detail specific issues which were found to be particularly relevant for the sector at stake" (p. 2) and looks to see if there are differences between the sub-sectors, textile versus clothing and footwear. The first issue relevant to the textile industry is the issue of technological innovation, the industry's attitude towards this issue and to what extent it is enabled by the internet is explored. The results showed that 35% of the enterprises in the sample "introduced substantially improved products or services to their customers in 2003" (p. 23). Of these, one third were directly related to or enabled by Internet-based technology. Internal processes were introduced by 22% of the respondents in 2003, about half of these were directly enabled by or related to Internet-based technology. The second relevant issue is the integration of the value chain. There is a low level of value chain integration within the textile, clothing in footwear industries, especially in the areas of online exchange of documents and production orders and in the digitalization and integration of commercial activities. The only area traditionally

integrated in this way is collaboration in product design, where companies have been using CAD/CAM software for many years. The study then goes on to present case studies on three European companies in the sector (one footwear company, one apparel company, and two textile companies using an e-marketplace that focuses on supply chain initiatives in the Italian textile industry) who have used technological innovation, value chain integration, and online collaboration with external partners to increase their competitiveness.

The limitations of this study included:

1. Limiting the geographical focus of the study to European Union and EEA (European Economic Area) countries.
2. Combining the textiles, clothing, and footwear industries (NACE codes 17, 18, and 19.3 respectively) into one grouping in the quantitative analysis so that no comparisons can be seen between sub-sectors. Also, a majority of the enterprises in the EU textile, clothing and footwear industries operate in the clothing sector, followed by the manufacture of footwear, with textile manufacturing accounting for the smallest number of enterprises.
3. Using a wide-angle perspective that does not allow for any in-depth analysis.

Cap Gemini Ernst & Young/CIPS conducted another survey of relevance. This bi-annual survey of 352 manufacturing companies in the UK included textile and clothing manufacturers but they were not the focus of the study. The main findings of this survey in terms of the textile and clothing sector are as follows (Cap 2003):

- 66.7% saw no change in cost savings from the introduction of e-commerce
- 57.1% currently use the internet “a little” to purchase goods and services

- 52.4% don't expect to use the internet to purchase direct goods and services within a year although they show the strongest expected growth between sectors with 19% expecting to do so within a year
- 42.9% currently use the internet "a little" for purchasing indirect goods and services
- 52.4% currently use the internet for purchasing of IT goods and services
- Textiles and clothing sector showed the lowest use of online purchasing by auction
- Reported the lowest use of online marketplaces (only 4%) and none expect to start using this type of marketplace to make purchases within a year
- 70.6% use the internet to identify new suppliers
- Textiles and clothing (57.1%) closely followed Electrical/Electronic engineering firms with the highest usage of the internet for supplier collaboration
- 76.2% do not expect to use the internet to invite tenders for contracts
- Manufacturers in the Textiles & Clothing sector were the greatest users of the Internet for B2B sales.
- Manufacturers in the Textiles, Clothing & Leather goods sector were the highest recorded users of the Internet for B2C sales in spring 2003.

Another study involving the textile industry is the study, "Electronic Commerce Business Impacts Project Textile-Clothing Sector In Italy". This study consisted of three case studies with companies from both ends of the value chain – one in yarn production and two in apparel production, focusing on their e-commerce initiatives (Bianchi 2001). Several other studies have focused on e-Marketplaces in Europe and

abroad (Andersen 2003; Eng 2002; Industry Survey for the AWI Wool Textile and Apparel Portal 2004) but none have been found that extensively study the use of e-business by textile manufacturing in the US. The US Department of Commerce has compiled some statistics on B2B e-commerce in manufacturing, but these statistics are limited as they are derived from a single question on the US Census Bureau's Annual Survey of Manufacturers. More detailed information needs to be collected in order to better understand the value of e-business to the US textile manufacturing industry, especially in its efforts to stay afloat among growing global competition.

Part IV: Summary

This chapter presents a taxonomy of the e-business models that classifies the models into the following categories:

1. sourcing models,
2. ownership models,
3. service-based models,
4. customer relationship management models,
5. supply chain models,
6. interaction models and
7. revenue models.

An initial review of the textile manufacturing related companies revealed that of the 590 listings from the chosen product headings, 26.6% of the listings had a website. Of the 79 companies that did have websites, only 15% of the companies actually sold goods via the Internet. However, all of the websites provided information on their company and contact information and 79.7% of the websites provided a catalog with

information on the company's products. All of the websites reviewed were privately owned. This does not mean, however, that they do not also do business through exchanges or other third party websites or even through a separate private website.

The literature available on the subject of e-business models is extremely diverse. There does not seem to be a general consensus on the best way to meaningfully group these models so that they are of some benefit to companies who are looking for a way to integrate an e-business solution. There are several papers that have made attempts to classify these models so that they will apply to all businesses, but they are all lacking in one way or another. Research to discover the areas that are most important to business needs to be done in order to develop e-business models that are meaningful.

Research is needed to determine the current status of e-business within the textile industry, to identify what the supply chain needs are and how e-business can be used to tie the supply chain together and to identify new opportunities to add value to the firm.

CHAPTER III

METHODOLOGY

Purpose of Research

The purposes of this research are to:

1. Provide an overview of the current the use of e-business initiatives by North Carolina textile manufacturers.
2. Provide the US textile industry information on where their peers in North Carolina expect to find the greatest benefits and challenges in terms of e-business initiatives.
3. Develop a conceptual model for evaluating B2B e-business solutions for the textile manufacturing industry.

Research Objectives

The specific research objectives are:

RO1. Identify e-business initiatives currently used by N.C. textile manufacturers.

RO2. Identify e-business initiatives being considered by N.C. textile manufacturers.

RO3. Identify benefits to adoption e-business initiatives.

RO4. Identify barriers to adoption e-business initiatives.

RO5. Determine which e-business initiatives N.C. textile manufacturers deem to be most important for achieving a more competitive strategy.

RO6. Develop a conceptual model of e-business for textile manufacturing.

The conceptual model consists of a qualitative description and diagram of the e-business strategy.

Research Design

The research design for this study consisted of a mixed methods approach, utilizing both quantitative research in the form of a questionnaire and qualitative research in the form of case studies. The questionnaire and interviews made up the primary research. The secondary research consisted of both qualitative and quantitative analysis of the textile industry in North Carolina. Creswell (2003) defines the mixed methods approach to research 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 involves 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" (p. 18).

The analysis of secondary sources, questionnaire and case studies were performed in sequential order. According to Creswell (2003), this procedure allows the researcher to "elaborate on or expand the findings of one method with another method" (p. 16). The inductive logic of research was followed in the first phase of the research, which is the analysis of secondary sources. Figure 3 shows the inductive logic model by Creswell.

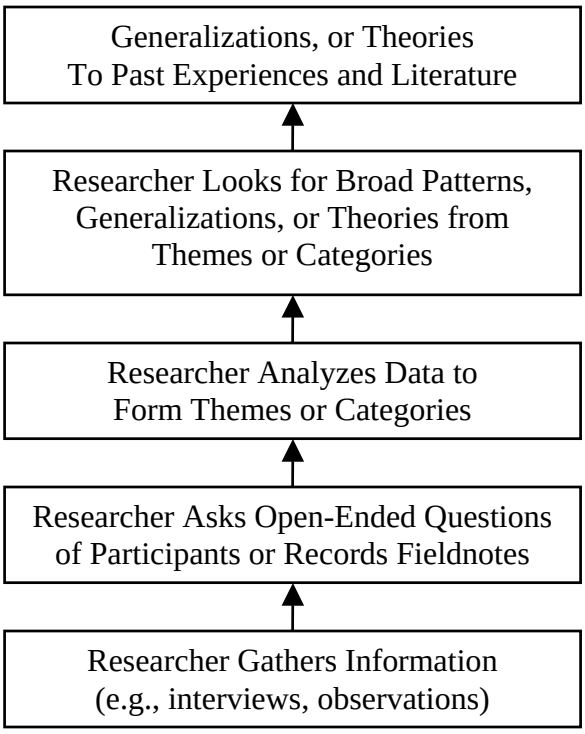

Figure 3: Inductive Model of Research

Source: Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Method Approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications. 132.

Next, the questionnaire based on the literature review and discussions with industry contacts and university faculty was developed and distributed. The questionnaire portion of the study followed the deductive logic of research as shown in Figure 4.

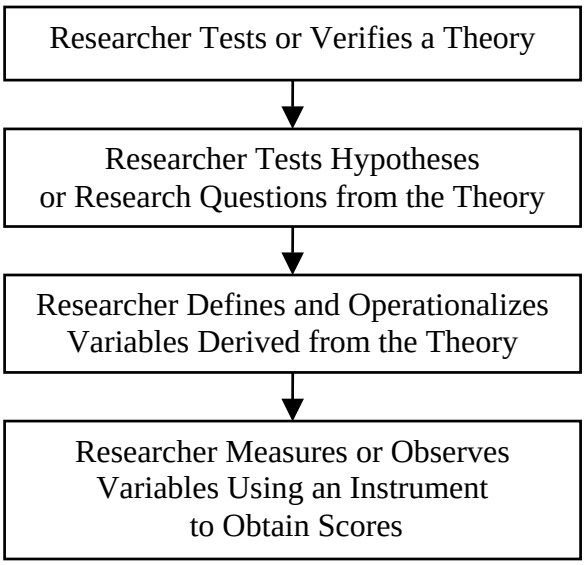

Figure 4: Deductive Model of Research

Source: Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Method Approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications. 125.

Finally, case studied were performed in order to expand on the results of the survey, adding clarity and depth to the quantitative analysis.

The analysis of secondary sources is referred to as Phase I of the research. The primary research is referred to as Phase II. The questionnaire portion of the study is referred to as Phase II-A and the case study portion is referred to as Phase II-B. The reasons for choosing this method of research are that:

1. The study was primarily exploratory in nature, and research first needed to be performed that would help to determine what issues are important to the industry. This was accomplished through analyzing secondary sources and through the use of a mail survey instrument.
2. Case studies were performed in order to assist in providing a more complete and detailed overview of the subject.

Phase I: Analysis of Secondary Sources

Phase I of the study:

1. Identified NC companies with primary NAICS code 313.
2. Analyzed financial reports, government data, and information found via Internet searches of a sample of companies identified to be part of the population.
3. Developed questionnaire based on the literature review and the analysis of secondary sources.

Population Identification

The first step of Phase I was to identify companies that were to be included in Phase II of the research. To be included in the population for this survey, companies:

1. Must have been categorized in one of the following NAICS classifications:
    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. Their US headquarters must have been located in North Carolina.
3. Their contact information must have been readily accessible.

Contact information on sample companies was collected and compiled from the following sources:

a. Contacts from professors at NCSU.
b. Contacts from the North Carolina Department of Commerce.
c. Companies listed in databases accessible to NCSU students:
    i. Thomas Register
    ii. Reference USA
    iii. Harris Selectory Online
    iv. Davisons Textile Blue Book

The reasons for limiting the population of the study to North Carolina and NAICS code 313 were as follows:

1. Most e-business interactions that this group will have will be with other businesses, not the end consumer.
2. North Carolina has the greatest number of establishments compared to other states in this group.
3. North Carolina is similar to entire US population in regard to the breakdown of this group into sub-groups.

According to the Census Bureau, Textile Mills are defined as:

> "Establishments that transform a basic fiber (natural or synthetic) into a product, such as yarn or fabric, that is further manufactured into usable items, such as apparel, sheets, towels, and textile bags for individual or industrial consumption. The further manufacturing may be performed in the same establishment and classified in this subsector, or it may be performed at a separate establishment and be classified elsewhere in manufacturing. The main processes in this subsector include preparation and spinning of fiber, knitting or weaving of fabric, and the finishing of the textile."[2]

Data Collection

Phase I of the research identified the initial list of companies to be contacted in Phase IIA. The following steps were performed in order to develop the database of North Carolina textile manufacturers.

Step 1: Database of textile and apparel manufacturers in North Carolina provided by the North Carolina Department of Commerce was sorted by primary NAICS code.

Step 2: Those companies with a primary NAICS code other than 313 were deleted from the database.

Step 3: A search for companies with NAICS code 313 was performed on ReferenceUSA.com and downloaded into Excel.

Step 4: The two databases were modified so that the headings matched and were then combined.

Step 5: The new database was sorted by company. Duplicate companies were deleted.

Step 6: The company information in the database was compared to information in

[2] http://www.census.gov/epcd/naics02/naicod02.htm

Davison's Textile Blue Book and Thomas Register to fill in any blank spaces and to verify that the company information was correct.

Next, in order to get a better idea of the textile industry in North Carolina, a random sample of companies identified and included in the database were reviewed. First, a search for public textile companies in North Carolina was performed. Only a very few companies were found to be publicly held. Therefore a search of all 5 of these companies was performed. The sources used to obtain secondary information on the public companies and the randomly selected private companies were 1) websites, 2) articles, and 3) government documents. The information found on these companies was entered into a spreadsheet and reviewed for trends.

The final step of Phase I was the development of a mail survey to be distributed in Phase II-A. The purpose of the questionnaire was to gather quantitative data on the use of e-business in the North Carolina textile manufacturing industry. A mail survey was chosen for several reasons:

1. All companies in the population will have a mailing address. If an email or web-based survey was used, the sample would be biased toward those companies that regularly use email and have Internet access.
2. A mail survey allows participants to complete the survey at a convenient time, rather than with telephone or in-person surveys that must be completed at the time of the phone call or interview.
3. Mailing addresses of companies can be more easily compiled than email addresses.

Instrument Development

The survey instrument was developed by the researcher and followed the guidelines recommended by Dillman (2000). The instrument consisted of nine questions based on the research objectives and the literature review, specifically the taxonomy of e-business models developed by the researcher. Also, questions from other studies were modified in order to allow for a comparison between this study and studies performed in Europe. Table 5 shows how the survey questions correlate to the research objectives.

Table 5: Survey Questions Correlated to Research Objectives

Research Objectives	Survey Questions
RO1 – E-business initiatives currently being used	Q1 Q2 Q3
RO2 – E-business initiatives being considered	Q2 Q3
RO3 – Benefits	Q4 Q6
RO4 – Barriers	Q7
RO5 – Most important initiatives for achieving a competitive strategy	Q5
RO6 – Conceptual model development	Q1-Q9

Demographic information was collected on the companies in Phase I of the research in order to avoid asking unnecessary questions that would make the survey longer and may, therefore, result in a lower response rate. Each company was assigned a number with demographic information already attached. This number that was placed on the lower, right-hand corner of the survey in order to assure that the correct demographic information was attached to the appropriate survey responses and also to identify which companies had responded to the survey. This information included: the number of

employees, the primary NAICS code, the title of the person to whom the survey was sent, and if it was a public or privately-held company.

The first two questions on the survey were included in order to determine if the company had a website, and if so, what types of services and information were included and which additional services/information they were planning to add to the website in the future. The services included background information on the company, industry news and information, product information, a product catalog, customer support, allowing customers to make electronic payments, logistics services, sales support, and online auctions. Question 1 required a yes or no response and represented binary level data. Question 2 had 10 parts and used nominal level data.

Question 3 was broken into 10 parts focused on how the company is currently using or planning to use online technologies for the following business activities:

- Collaborating with business partners in the design of new products,
- Collaborating with business partners to forecast product demand,
- Managing capacity or inventory,
- Exchanging documents electronically with suppliers,
- Purchasing MRO (manufacturing, repair, and operating) goods,
- Purchasing direct production goods,
- Selling goods domestically,
- Selling goods internationally,
- Managing customer relationships,
- Managing supplier relationships, and
- Logistics management.

This question represented nominal level data.

Question 4 represented ordinal level data. The intent of this question was to determine the effect that e-business has had on different areas of their business.

Question 5 represented binary level data and was intended to determine which areas textile executives expect to see the greatest benefits from e-business in the near future. The choices include customer relationship management, supplier relationship management, product development, logistics management, supply chain management, and information exchange. An open-response was also possible for this question. Because of the exploratory nature of the research, respondents may have had experiences not covered by the choices and this was a way to address any possible answers that may have been overlooked.

Question 6 also represented binary level data and was intended to determine where textile companies are experiencing the greatest benefits from their e-business solutions. The potential benefits include reduced cost, increased turnover, increased efficiency, improved communication with customers or suppliers, increased profits, improved communication with staff, a more competitive organization, better access to information, increased market share, improved quality of products and services, improved delivery time to customers, and increased responsiveness to customers. An open-response was also possible for this question.

The intent of question 7 was to determine what kind of barriers may be deterring textile manufacturing companies from using e-business. This question represented binary level data and included the following choices along with an open response option: Lack of shared technical standards, security issues, data protection or privacy issues, business

messaging or transaction processing, cataloging and classification issues, initial cost is too high, time constraints, lack of skilled staff, readiness of business partners, lack of support from upper management, lack of proven business benefits, and lack of direct customer contact.

Question 8 was the only demographic question included on the survey. The purpose of this question was to determine where the respondent's company manufactured goods (U.S., abroad, both, no manufacturing) so that possible comparisons could be made between respondents that manufacture in the US versus those that manufacture abroad.

Question 9 was an open-response question that was added in order to allow respondents to address any other issues that they felt were important.

The final page of the survey was included in order to determine which companies wanted to receive a summary of the results of the study and also to determine which companies would be interested in participating in the case studies.

Field Test

The field test of the questionnaire was conducted by distributing the initial survey in paper format to a group of textile industry executives attending a conference at NCSU in the Spring of 2005. These field test participants were also given an additional questionnaire to evaluate the survey instrument. A copy of the field test, field test cover letter, and the survey evaluation form are included in the Appendices. The purpose for the field test was to determine:

1. How long the survey took to complete.
2. If there is was any confusion concerning the wording of the survey questions.

3. To determine if there were any questions deemed important by field test respondents that were overlooked by the survey.

The field test was taken by 15 industry executives. The survey was revised based on the results of this initial pilot study and suggestions from survey participants. Based on the responses to the field survey, examples from Dillman (2000), and suggestions from NCSU faculty, the following changes were made to the final survey: the rank order questions were confusing and were changed so that no ranking was included, the demographic information questions were removed, and the design of the survey was changed. The field test respondents also indicated that the survey took less than 15 minutes to complete. A copy of the final survey is included in Appendix E.

Phase II-A: Questionnaire Distribution

In Phase II-A, the final version of the questionnaire developed in Phase I was distributed and the responses were collected and recorded.

Data Collection

Data was collected from a mail survey distributed to the entire population of textile manufacturing companies (NAICS 313) with headquarters in North Carolina, as determined in Phase I of this study. In order to maximize the response rate of the survey, Dillman's Tailored Design Method was used. This method consists of the following steps (2000):

1. Send brief prenotice letter to respondent a few days prior to questionnaire.
2. Send questionnaire and detailed cover letter explaining the importance of the questionnaire.

3. Send a thank you postcard a few days to a week after sending the questionnaire and cover letter.
4. Send a replacement questionnaire to nonrespondents 2 weeks after the initial questionnaire mailing.
5. Make a final telephone call to nonrespondents urging them to respond to the questionnaire (p. 151)

Step one was modified. Instead of sending a prenotice letter, as recommended by Dillman, each of the companies on the list compiled in Phase I was called. They were told about the survey and were asked permission to mail it to them. If they agreed, they were then asked to verify their address and the name of the contact person. If there was no answer, a second phone call was made on another date. The reasons for replacing this step were to increase the response rate:

1. By avoiding sending the surveys to companies no longer in business, who had a company policy against filling out surveys, or were not textile manufacturers and
2. By verifying the address and contact name in order to eliminate returned surveys due to outdated information.

Copies of the cover letter, thank-you postcard, and replacement questionnaire cover letter are included in the appendices. The cover letter and survey were sent as soon as possible following the initial phone call and included:

1. a request for survey participation,
2. an explanation of the survey,
3. the reasons why the survey is important to the textile industry,

4. promise of confidentiality,
5. an incentive for completing the survey in the form of summary results for those interested and
6. the researchers contact information, including email, telephone number and mailing address.

The thank-you card was sent approximately one week after the initial survey and cover letter. This postcard was sent to the entire sample and served as a thank-you for those who had returned the survey already and as a reminder for those who had not returned the survey yet to do so. About two weeks after the thank-you postcard was sent, a follow-up letter along with another copy of the survey was sent only to the non-respondents. The follow-up letter included:

- a paragraph informing them that their survey had not yet been received,
- an explanation of the survey purpose,
- the reason why their survey response is important to the research,
- a paragraph asking those who were incorrectly identified as textile manufacturers to respond so that they can be removed from the mailing list,
- a promise of confidentiality, and
- the researcher's contact information.

Once the survey was returned, the data was manually entered into an Excel database. The data collection period lasted from August 11, 2005 until October 10, 2005.

Sample Selection

The entire population of companies identified in Phase I of the research was called by the researcher.

Response Rate and Useable Sample Size

Response rate is "generally accepted to designate the ratio of the number of completed interviews divided by the number of eligible units in the sample" (CASRO 1982). The goal of Phase II-A was to achieve a response rate of 21% or better. According to Dillman (2000), "a review of 183 business surveys (in selected business journals published since 1990) revealed an average response rate of 21%" (p. 323).

Data Analysis

Since the study was exploratory in nature, there were no testable hypotheses. Instead summary statistics compiled from the survey responses were used to aid in answering the research questions previously listed. In Obilade's (2002) dissertation, she explains that exploratory research design is for theory building and not theory testing: "Exploratory research can assist the researcher to better define and describe the problem. It can lead to a deeper understanding about a problem or question, which may then lead to theory development." This quote describes why hypothesis testing was not relevant for an exploratory study.

Data analysis was conducted by first coding the survey and developing a spreadsheet in Excel. Coded survey answers and demographic information were entered into the spreadsheet. The data was sorted in several ways, by NAICS code, by number of employees, and by manufacturing location. Descriptive analysis was performed in order to determine if there were any trends in the use of e-business in the N.C. textile industry as a whole as well as to determine if there were any differences in these trends in companies in different sectors, with different employment sizes, or with manufacturing in

different locations. Table 6 shows how the companies were grouped to perform this analysis.

Table 6: Grouping of survey answers for data analysis

Grouping 1	**Number of Empolyees**	**Grouping 2**	**NAICS codes included**	**Grouping 3**	**Where companies manufacture**
Micro	1-10 Workers	**Fabric Mills**	313210, 313221, 313230, 313241, 313249	**US**	Manufacture in the US only
Small	11-50 workers	**Yarn, thread, and yarn texturizing Mills**	313111, 313112, 313113	**Abroad**	Manufacturing abroad only and manufacturing both in the US and abroad
Medium	51-250 workers	**Fabric coating and finishing Mills**	313311, 313312, 313320		
Large	More than 250 workers				

Phase II-B: Case Studies

Case studies were performed in Phase II-B of the research in order to expand on the information collected through the survey phase. Interviews 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 to the industry through the questionnaire. They also allow for explanations for why survey questions may have been answered in a particular way. This information was then used (along with survey results) to construct e-business models prevalent in the textile industry.

Instrument Development

Although case studies are still a fairly new research method, there has still been a good deal of research done on the methodology. According to Tellis (July 1997) “case study can be seen to satisfy the three tenets of the qualitative method: describing, understanding, and explaining”. According to Yin, six types of information can be used in combination to generate a case study. These six types of information are documentation, archival records, interviews, direct observation, participant observation, and physical artifacts (Yin, 1994). This study used documentation, archival records, and interviews. Open-ended interviews were conducted with companies who agreed to participate and meet the sample selection limitations that are listed later in this section. According to Tellis, “with an open-ended interview, the researcher could ask for the informant's opinion on events or facts. This could serve to corroborate previously gathered data” (Tellis, September 1997). The interviews were conducted keeping the research objectives and survey responses in mind, so that a more in-depth understanding of the issues identified by the survey as most relevant to the textile manufacturing industry could be achieved and the research objectives could be answered. The interviews were conducted according to the interviewee's schedule and availability, within the time frame allotted for the case study phase of the research. A majority of the interviews were conducted in person, with only one conducted by telephone.

Sample Selection

A convenience sample was used based on the following criteria:

1. Companies that had agreed to participate by indicating an interest in participating in further research on the Phase II-A survey or had been

contacted by the researcher based on a recommendation from industry professionals or university faculty.

2. Companies were selected from the population so that there was a sampling from the NAICS categories listed in Phase I.
3. Company was able to schedule the interview within the timeframe specified for Phase II.

Data Collection

Data was collected from interviews that were scheduled at a time and place convenient to the interviewer and within the time frame specified for Phase II-B of the study. Secondary data about the company was collected prior to the interview.

Data Analysis

Information collected from interviews was converted into paragraph form, comparisons were drawn, and information was used to develop the business models. The case studies were analyzed using information collected from the interviews along with the secondary data to aid in the development of meaningful e-business models for the textile manufacturing industry.

CHAPTER IV

RESULTS

Phase I Sample Development

The main objective of Phase I of this research was to develop a database containing the population of textile manufacturing companies in North Carolina. There were determined to be 307 confirmed textile manufacturing companies in North Carolina with a primary NAICS code of 313. Table 7 shows how these companies are distributed by NAICS code, corporate sales description, number of workers and ownership.

Table 7: Breakdown of Textile Manufacturing Companies (NAICS 313) in N.C.

NAICS Code			Corporate Sales Description			Number of Workers			Ownership		
	#	%		#	%		#	%		#	%
313111	46	15.0%	Less than $500,000	22	7.2%	1-10	98	31.9%	Public	4	1.3%
313112	1	0.3%	$500,000 – 1M	30	9.8%	11-50	104	33.9%	Private	303	98.7%
313113	11	3.6%	$1M – 2.5M	63	20.5%	51-100	33	10.7%			
313210	50	16.3%	$2.5M – 5M	50	16.3%	101-250	40	13.0%			
313221	20	6.5%	$5M – 10M	44	14.3%	251-500	11	3.6%			
313222	1	0.3%	$10M – 20M	39	12.7%	501-1000	9	2.9%			
313230	6	2.0%	$20M – 50M	39	12.7%	More than 1000	12	3.9%			
313241	17	5.5%	$50M – 100M	3	1.0%						
313249	14	4.6%	$100M – 500M	12	3.9%						
313311	42	13.7%	More than 500M	3	1.0%						
313312	91	29.6%	Not listed	2	0.6%						
313320	8	2.6%									

The population of companies in North Carolina range from very small companies with less than 10 workers and with sales less than $500,000.00 per year to companies with more than 1000 workers and sales in the billions. A majority of these companies are privately held, with only 4 companies listed in EDGAR[3] as public companies. The only publicly owned textile manufacturing companies with a primary NAICS code of 313 are American & Efird Inc., Hanes Co. Inc., Unifi Inc., and Burke Mills Inc. Culp Inc., is also listed as a public company but is not included in the database due to the fact that they could not be contacted. Textile & fabric finishing (except broadwoven fabric) mills make up the highest percentage of the survey population with 29.6%. Those companies with sales of $1 – 2.5 million represent 20.5% of the survey population. Smaller companies make up a majority of the survey population. Those with 1 – 10 workers make up 31.9% and those with 11 – 50 workers make up 33.9% of the survey population.

The survey was developed as described in the Methodology section of this paper. A copy of the final survey is included in Appendix E. Phase II-A describes the results of the survey, including the sample description and the analysis of the survey responses.

Phase II-A

Sample Description

The entire population of companies identified in Phase I of the research was called by the researcher, 590 companies in all were called. The number of surveys sent was 328. The reasons for not sending surveys to all the companies are listed in Table 8.

[3] EDGAR is the U.S. Securities and Exchange Commission's Electronic Data Gathering, Analysis, and Retrieval system and is available at www.sec.gov/edgar.

Table 8: Number of companies and reasons for removing from mailing list

Reasons for not sending companies a survey based on telephone call	Number of companies removed from mailing list
The plant is closing	15
Not a textile manufacturing company	75
Number was disconnected/not working	71
Company is no longer in NC	3
Company was already contacted	22
Said not to send	19
No one answered the phone	16
Did not return phone call after two calls to the company	42
Total companies removed	263
Total companies surveys were mailed to	590-263=327

The response rate and usable sample size were determined by the following steps:

1. Companies who surveys were returned as "undeliverable" by the post office were removed.
2. Companies who replied saying that they were not textile manufacturers were removed.
3. Surveys returned unanswered were removed.

After the phone calls were made and the initial cover letters and surveys were sent, 4 of the packages were returned as "undeliverable", 8 companies wrote back saying they were not textile manufacturing companies, and 4 surveys were returned unanswered. After eliminating these companies from the 327 that were sent a survey, the usable sample size was 307. The number of usable surveys returned was 117, resulting in a response rate of 38.1% which exceeds the goal of 21 percent. Table 9 summarizes how the response rate was determined.

Table 9: Steps for Determining the Number of Usable Responses and Response Rate

	Number of Respondents
Number of surveys sent	327
Undeliverable	-4
Returned - not textile manufacturers	-8
Duplicate surveys returned	-1
Blank surveys returned	-4
Returned - not NAICS 313	-3
Confirmed Textile Manufacturers	307
Surveys not returned	-190
Final number of usable responses	**117**
Response Rate	**38.1%**

The number of usable responses to the questionnaire was 117 companies. Table 10 shows how the respondent companies were distributed by NAICS code and how the percentage of responses in each group compares to the entire population. There were responses from each NAICS code category, with the exception of Schiffli machine embroidery and nonwoven fabric mills. These two categories only made up 0.3% and 1.9% of the total population, respectively. The distribution of respondents by NAICS category is similar to that of the population.

Table 10: Number of respondents by NAICS code.

NAICS Code	NAICS Description	Number of companies	Percentage of Respondents	Percentage of entire population
313111	Yarn spinning mills	20	17.1%	15.0%
313112	Yarn texturizing, throwing, & twisting mills	1	0.9%	0.3%
313113	Thread mills	5	4.3%	3.6%
313210	Broadwoven fabric mills	24	20.5%	16.3%
313221	Narrow fabric mills	6	5.1%	6.5%
313222	Schiffli machine embroidery	0	0%	0.3%
313230	Nonwoven fabric mills	0	0%	2.0%
313241	Weft knit fabric mills	7	6.0%	5.5%
313249	Other knit fabric & lace mills	4	3.4%	4.6%
313311	Broadwoven fabric finishing mills	14	12.0%	13.7%
313312	Textile & fabric finishing (except broadwoven fabric) mills	33	28.2%	29.6%
313320	Fabric coating mills	3	2.6%	2.6%

Table 11 shows the breakdown of respondent companies by the number of employees and percentage in each category compared to the entire population. Again, the percentage of respondents per category is similar to that of the entire population.

Table 11: Number of respondents by size (number of employees).

Number of Employees	1-10 workers	11-50 workers	51-100 workers	101-250 workers	251-500 workers	501-1000 workers	More than 1000 workers
Number of Respondents	40	36	13	16	4	4	4
Percentage of Respondents	34.2%	30.8%	11.1%	13.7%	3.4%	3.4%	3.4%
Percentage of entire population	31.9%	33.9%	10.7%	13.0%	3.6%	2.9%	3.9%

The companies represented in this study were separated into groups based on NAICS code and business size in order to see if there were any differences in survey responses between different groups. Table 12 shows how the companies were grouped,

how many companies responded in each group and the percentage of total responses represented by each group. It is important to note that the total for the location group is only 98. This is due to the fact that some respondents did not answer this question on the survey (n=11) and some of the respondents were not manufacturers (n=8).

Table 12: Number of respondents and percentage per group.

Employment Group			NAICS Group			Location Group		
Grouping 1	**n**	**%**	**Grouping 2**	**n**	**%**	**Grouping 3**	**n**	**%**
Micro 1-10 Workers	40	34.2 %	**Fabric Mills**	41	35.0%	**US**	72	73.5%
Small 11-50 workers	36	30.8%	**Yarn, thread, and yarn texturizing Mills**	26	22.2%	**Abroad**	26	26.5%
Medium 51-250 workers	29	24.8%	**Fabric coating and finishing Mills**	50	42.7%			
Large More than 250 workers	12	10.2%						

Phase II-A Survey Results

RO1: Identify e-business initiatives currently used by textile manufacturers

Survey questions 1, 2, and 3 related to Research Objective 1. A total of 64% of respondents reported having a website. *Product information* and *background information on the company* were the most popular services reported to be offered on the respondents' websites. Figure 5 shows the percentage of companies in each of the employment groups compared to each other and to the total sample. There is not much of a difference in percentage of responses for most of the groups. *Customer Support* is provided by a larger share of the medium sized companies, online ordering is provided by a larger percentage

of the micro companies, and logistics and sales support are offered by a greater share of the large companies.

There does seem to be a difference in having a website between the employment groups and the manufacturing location groups. A greater percentage of large and medium sized companies (in terms of number of employees) have a website than do small and medium companies, which are close to the average for all groups. Of the large companies surveyed 83.3% reported having a website and 74.1% of the medium companies reported having a website. Also, a greater percentage of companies that have manufacturing facilities abroad (84 %) compared to those who only manufacture goods domestically (64%). There was not much of a difference between the percentages of NAICS groups that have a website, although the fabric group is slightly lower with 56.8% of the companies in this group having a website.

The data obtained by the e-Business Watch found similar results in how textile companies are utilizing their websites. The study reports that (2005):

> "Data from the survey about e-commerce confirm that online sales are not widespread and are generally an additional channel to traditional distribution. In this industry, the web is used primarily as a way to relate to customers and suppliers but with a limited degree of interaction" (p. 55).

Figure 6 shows the percentage of companies in each of the manufacturing groups compared to each other and to the total sample. The figure shows what percentage of the respondents by group are currently using website services. A higher percentage of the respondents in the yarn manufacturing segment are currently using six of the nine

possible services: *industry news and information, product information, customer support, logistics services, sales support,* and *online auctions*.

Figure 7 illustrates the differences in question 2 between companies who manufacture exclusively in the US and those that have manufacturing abroad. A greater percentage of those companies that have manufacturing abroad currently offer all of the services, with the exception of *industry news and information*. It is important to note that for this group, when the groups are combined, the total number of companies is less than the all sector total. This group was formed from answers to question 8 on the survey. Not all respondents answered this question and some respondents responded that they have no manufacturing facilities. These responses are not included in either group.

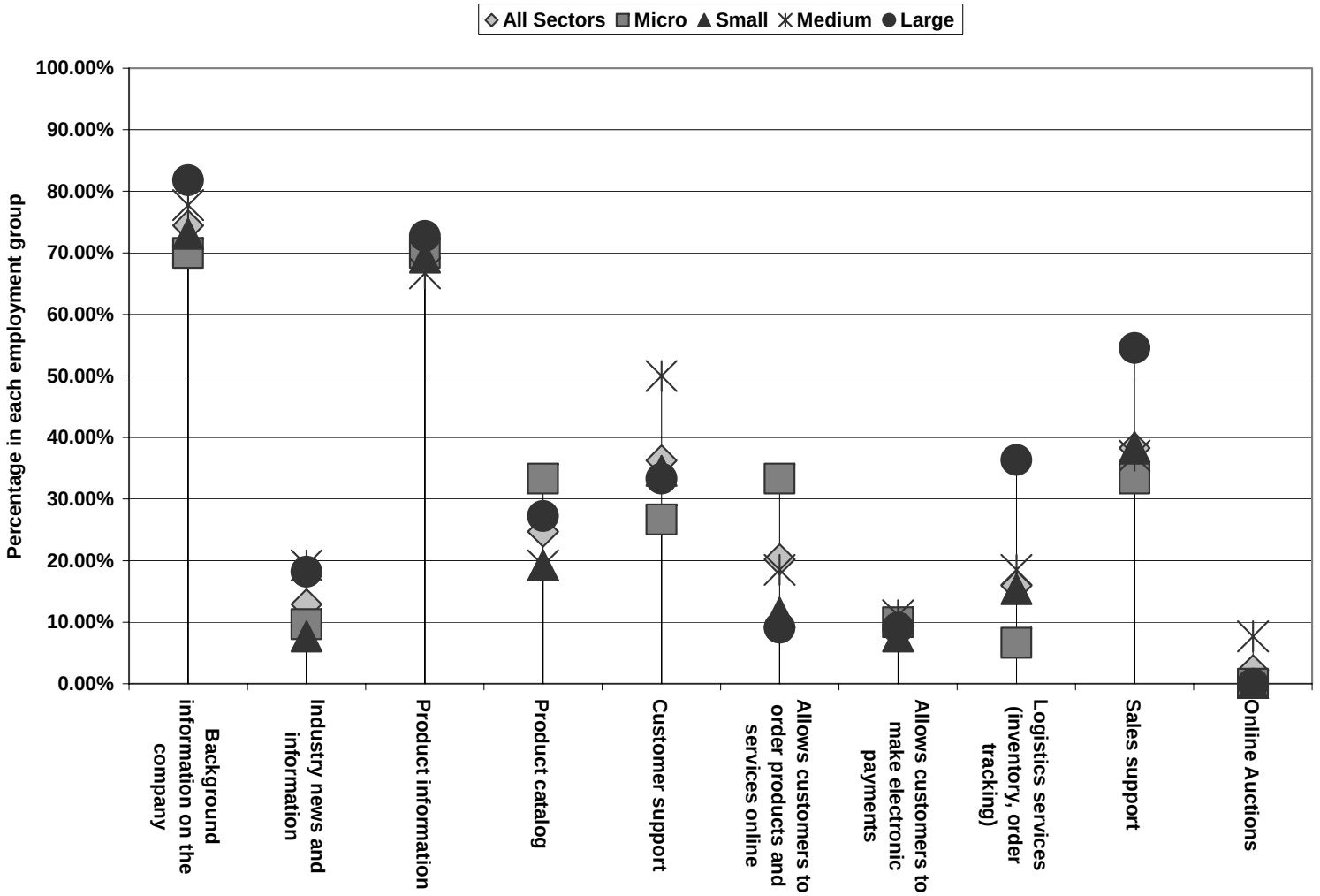

Figure 5: Q2 - Services currently offered on website by percentage of responses and employment group.

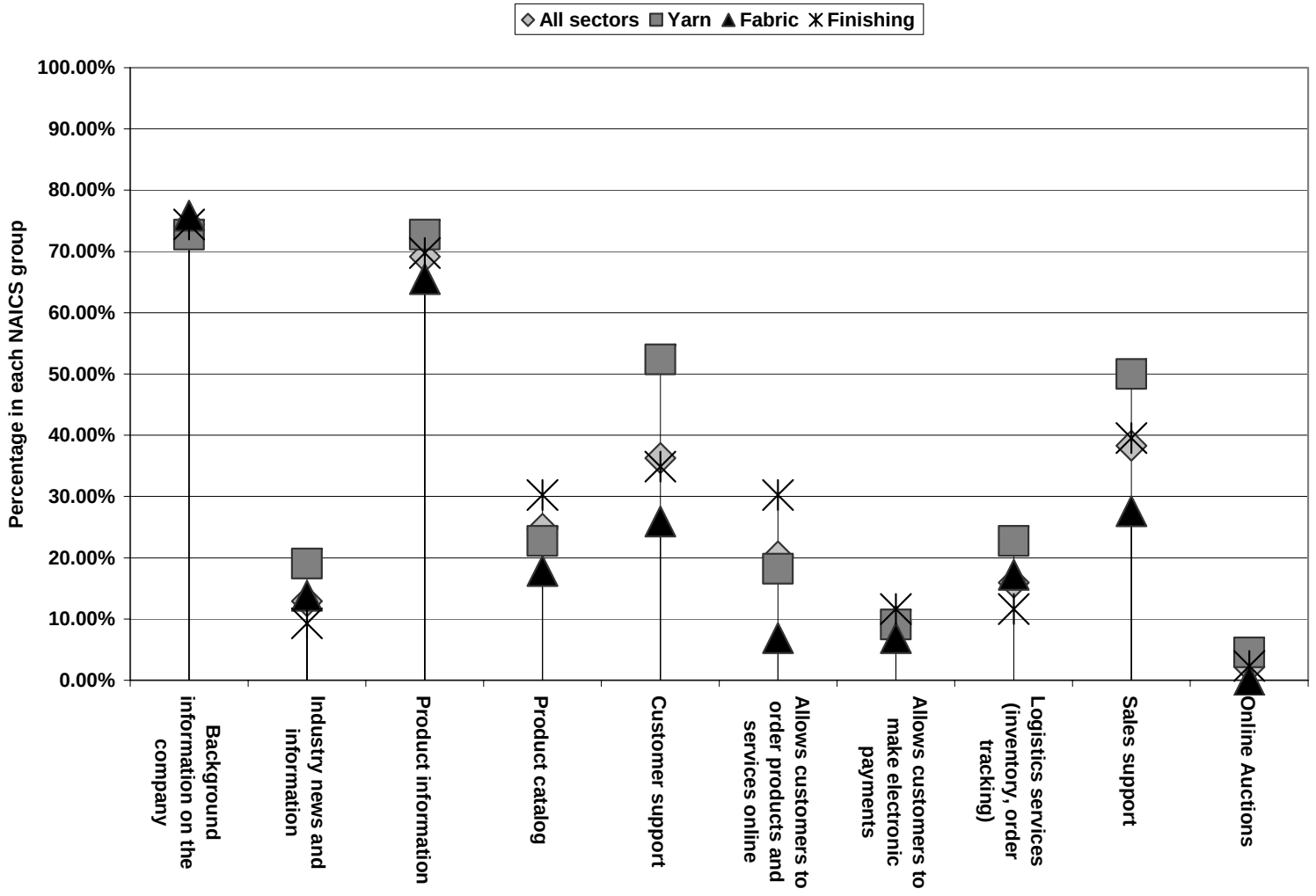

Figure 6: Q2 - Services currently offered on website by percentage of responses and NAICS group.

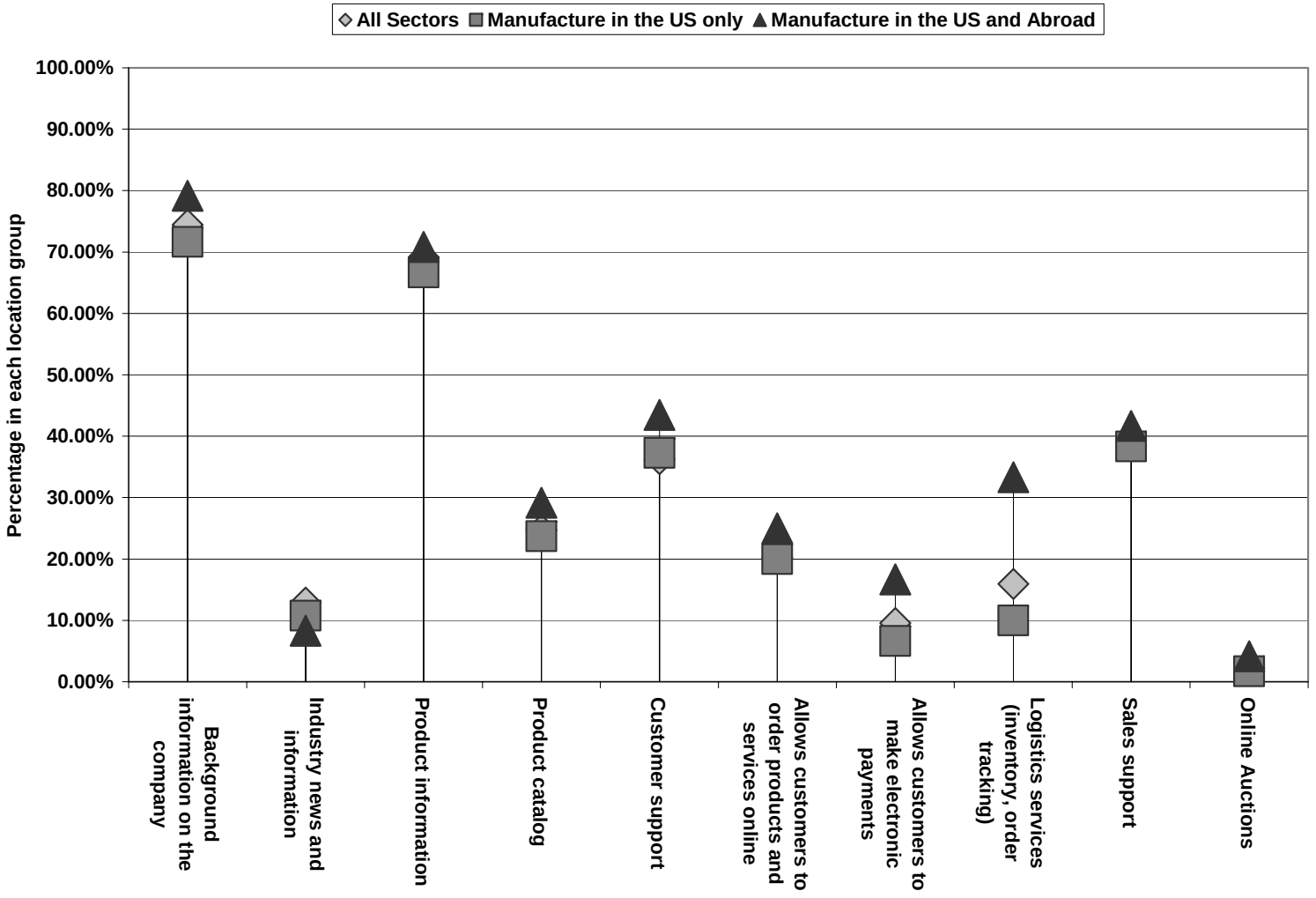

Figure 7: Q2 - Services currently offered on website by percentage of responses and manufacturing location group.

Survey question three was used to determine how textile companies are currently using online technologies to facilitate business activities. By far, the business activity most often facilitated by online technologies is *exchanging documents electronically with customers and suppliers*. 58.1% of the respondents that answered this question said that they currently do this. As shown in Figure 8, this is even more so with large companies. Greater than 80% of the large companies surveyed currently use online technologies for exchanging documents electronically with their business partners. *Selling goods domestically* is the second most popular business activity facilitated by electronic means with 32.7% of respondents who answered this question currently engaging in this activity.

Figure 8 also shows that a much greater percentage of large companies use online technologies to *manage supplier relationships* than do all other groups. Close to 50% of the large companies *manage their supplier relationships* in this way compared to the average of around 28%.

Figure 9 shows the differences in percentage of responses for question 3 between the NAICS groups. A greater percentage of finishing companies *sell goods domestically* with the help of online technologies. On the other hand, a smaller percentage fabric producers *sell goods* both *domestically* and *internationally* than do yarn, finishing, and the all sector average.

Figure 10 shows that a greater percentage of companies with some manufacturing facilities abroad use online technologies to facilitate all of the business activities mentioned with the exception of *selling goods domestically*. A greater percentage of domestic manufacturers *sell goods domestically* with the help of online technologies.

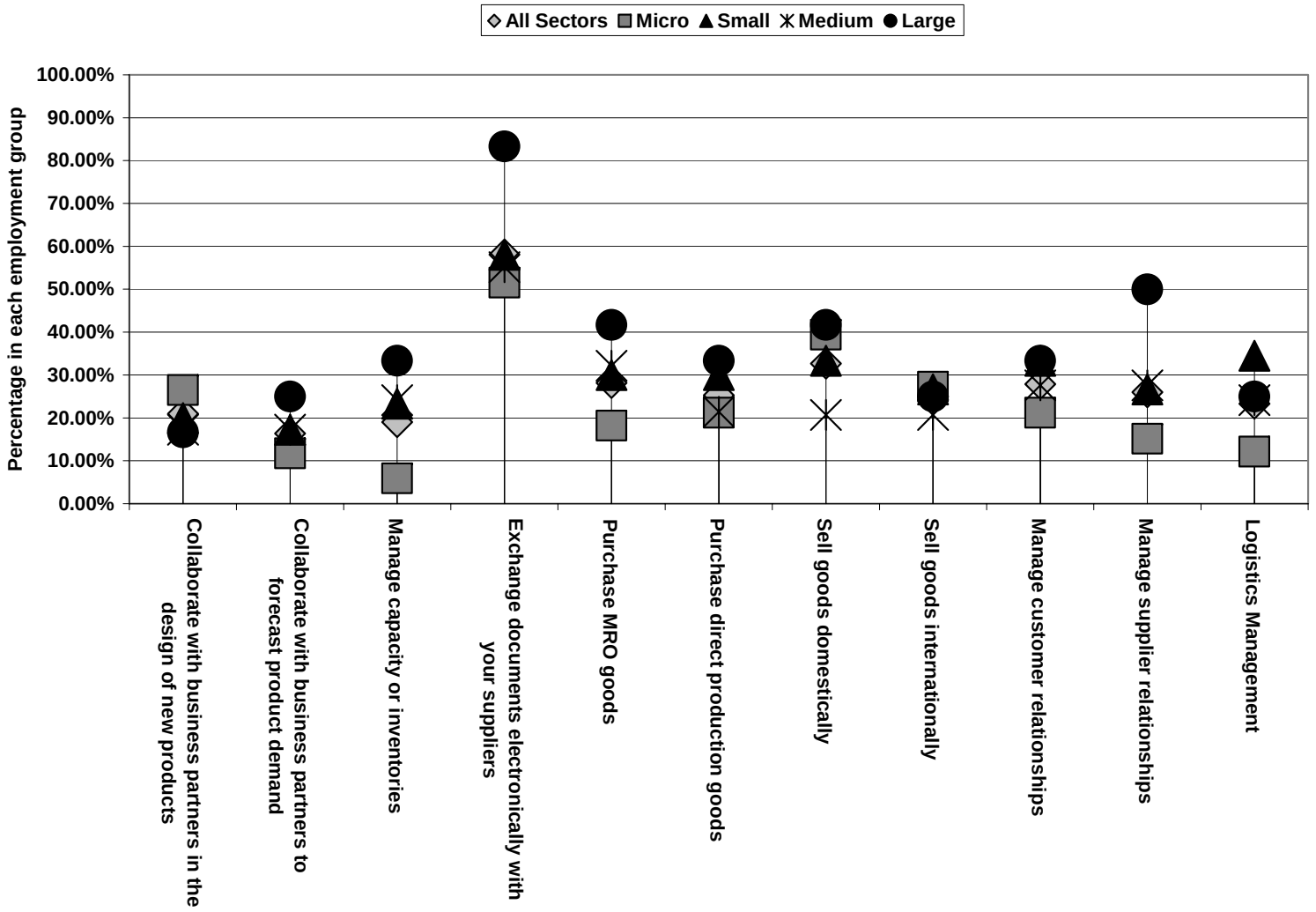

Figure 8: Q3 - Business activities currently facilitated by online technologies by percentage of responses and employment group.

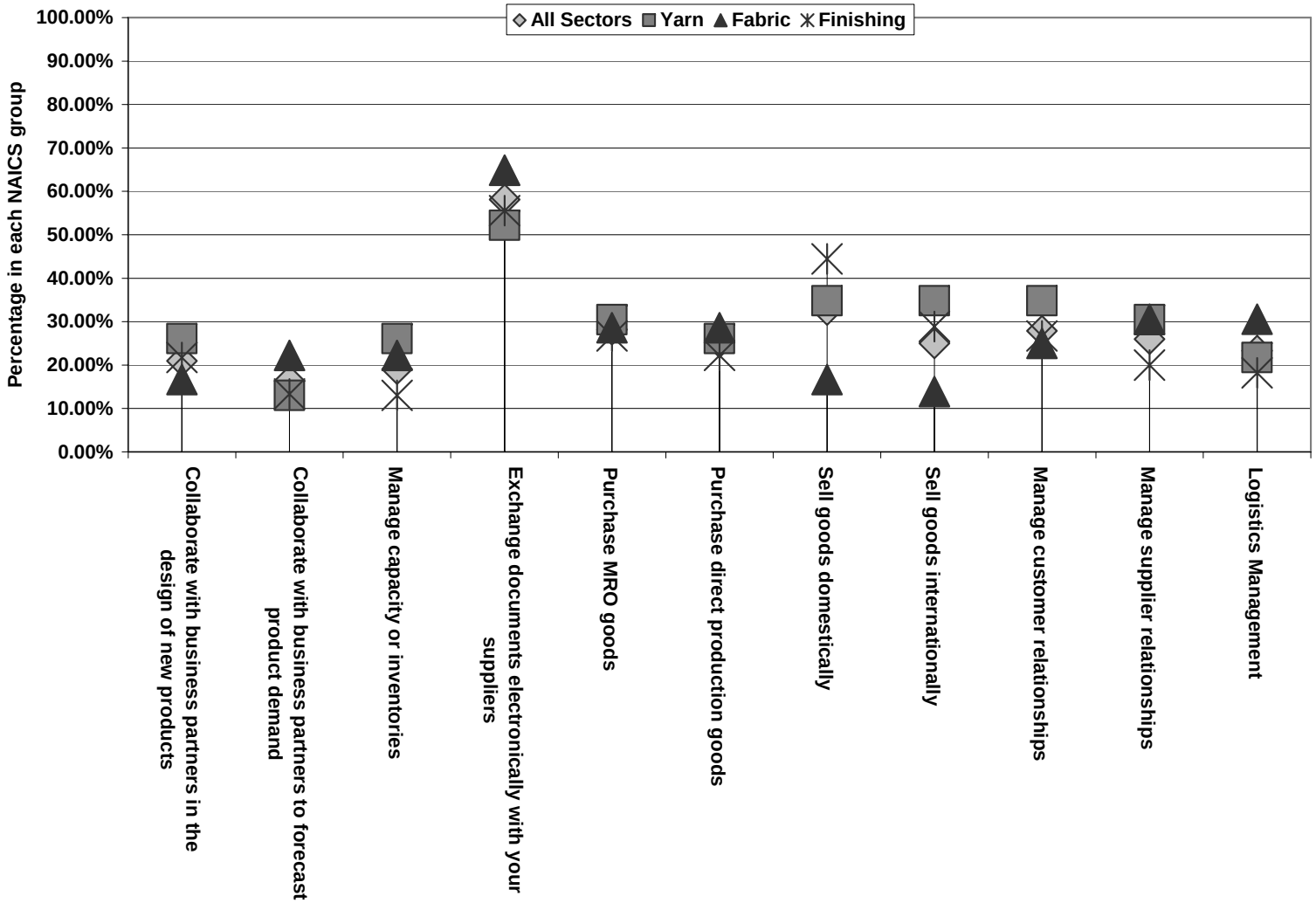

Figure 9: Q3 - Business activities currently facilitated by online technologies by percentage of responses and NAICS group.

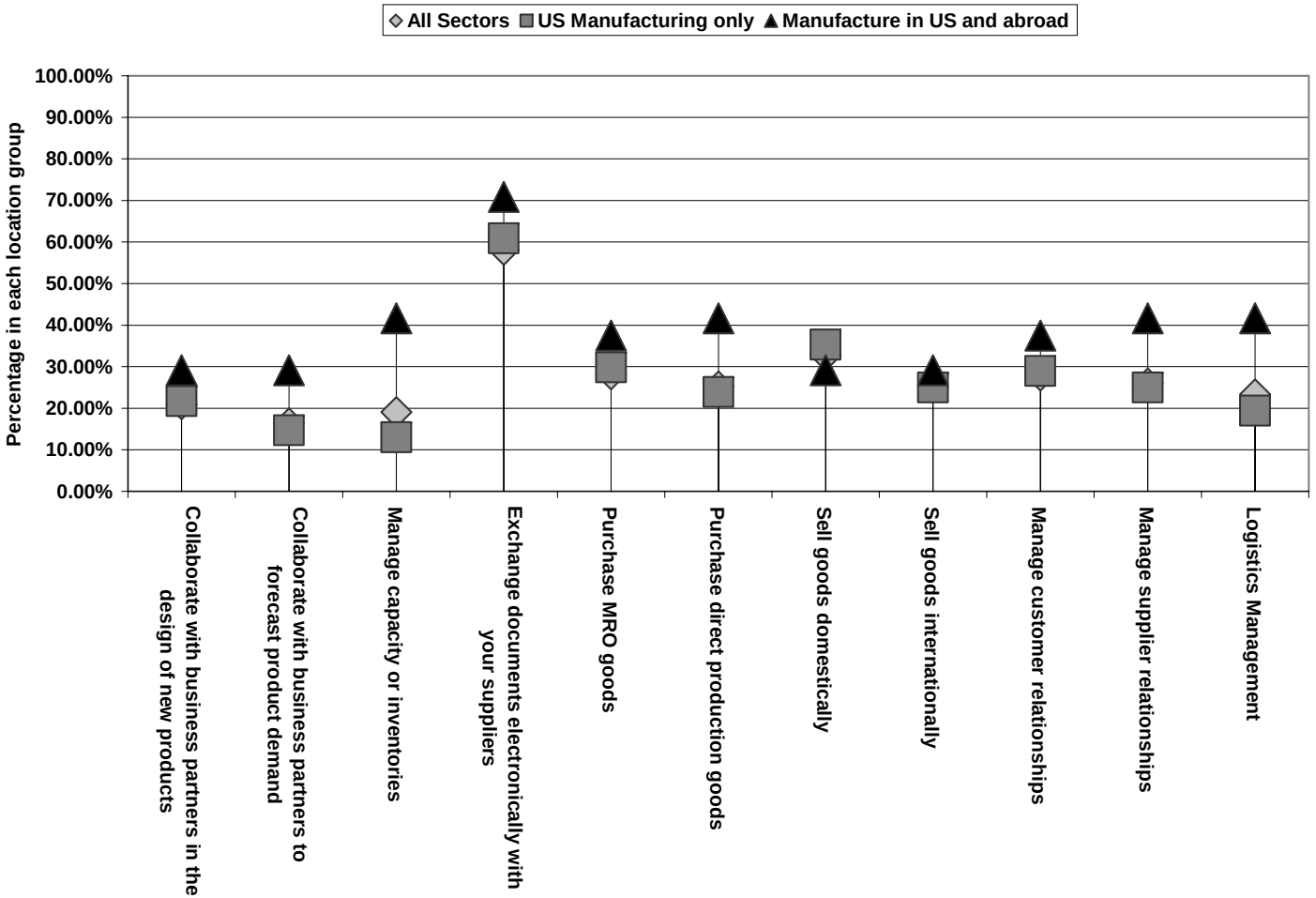

Figure 10: Q3 - Business activities currently facilitated by online technologies by percentage of responses and by manufacturing location group.

RO2: Identify e-business initiatives being considered by textile manufacturers

According to the survey responses from question two on the questionnaire, *sales support, logistics services,* and *customer support* are the top three services that survey respondents reported having plans to add to their website in the future. Eighteen respondents plan to add sales support to their website in the next 5 years, 5 respondents plan to do so in the next six months. Twenty respondents plan to add *logistics services* to their company's website in the next 5 years and one respondent plans to do so in the next 6 months. Sixteen respondents plan to add *customer support* services to their company's website in the next 5 years and 4 respondents plan to do so in the next 6 months (see Figure 11).

Figure 12 shows the percentage of companies in each of the employment groups compared to each other and to the total sample. The top two services planning to be offered by large and micro companies are *logistics services* followed by *customer support* while the top service to be offered in the future by medium sized companies is *a product catalog*.

Figure 13 shows the percentage of companies in each of the manufacturing groups compared each other and to the total sample. The figure shows what percentages of the respondents by group are planning to use website services in the future. None of the yarn manufacturers are planning to *allow customers to order online*. The services that the highest percentage of finishing companies are planning to offer on their website are *logistics services* followed by *customer support* while the highest percentage of fabric manufacturer are planning to offer a *product catalog*.

Figure 14 illustrates the differences in question 2 between companies who manufacture exclusively in the US and those that have manufacturing abroad. A greater percentage of those companies that have manufacturing abroad are planning to offer all of the services, with the exception of *product information* and *logistics services*. A larger percentage of companies who only manufacture in the U.S. are planning to add these services to their website.

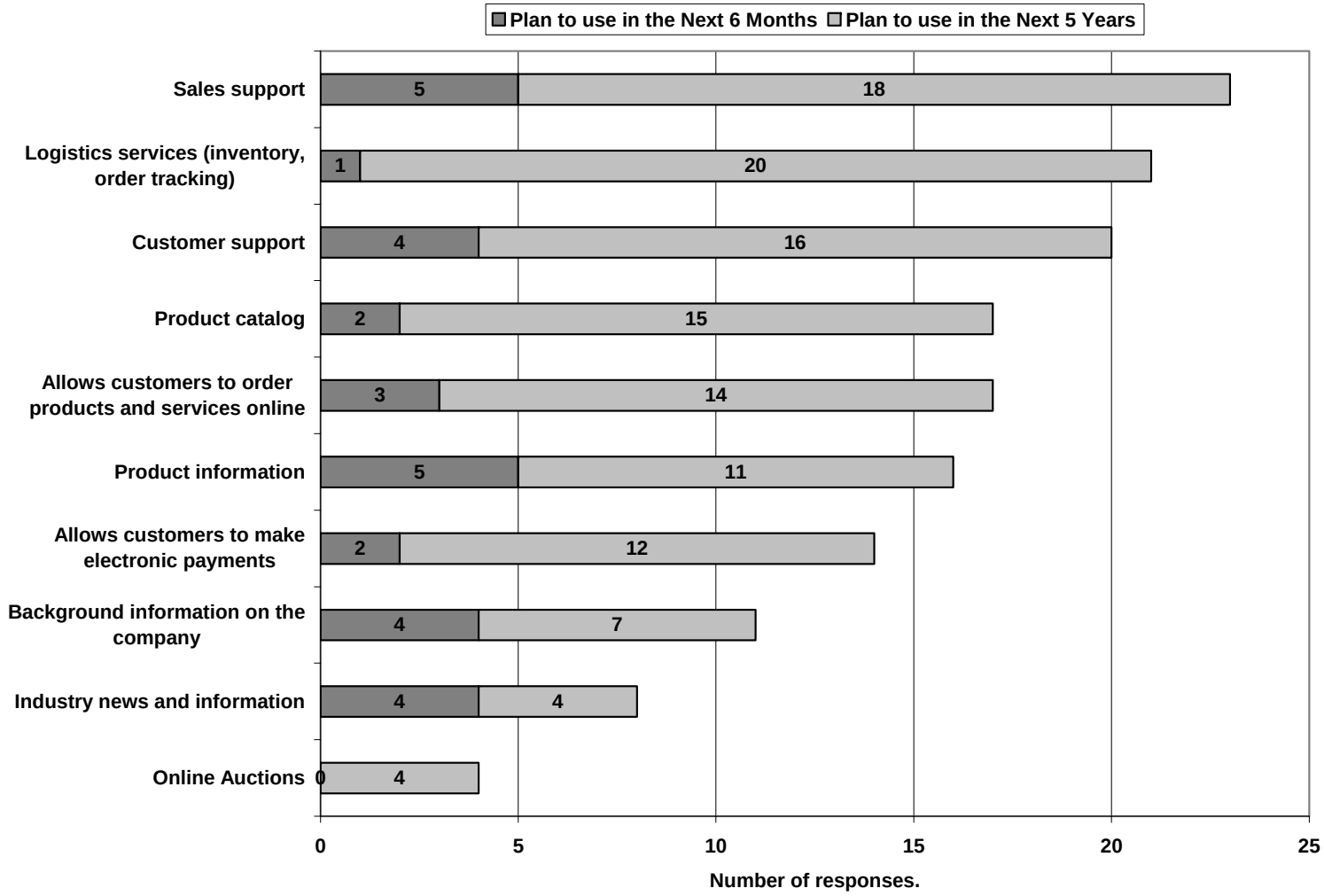

Figure 11: Q2 - Total number of responses planning to offer the above services on their website in the future.

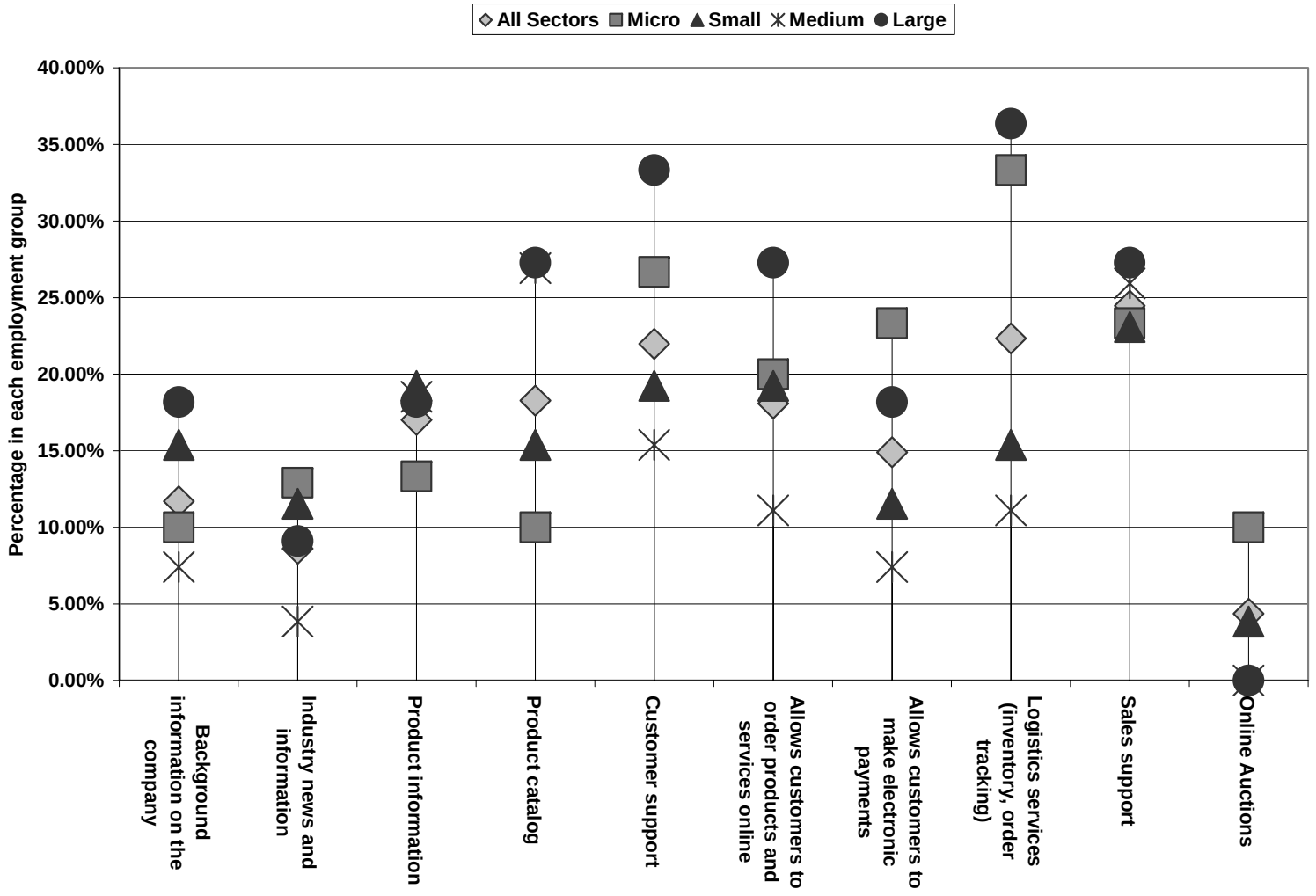

Figure 12: Q2 - Services planning to be offered on website by percentage of responses and employment group.

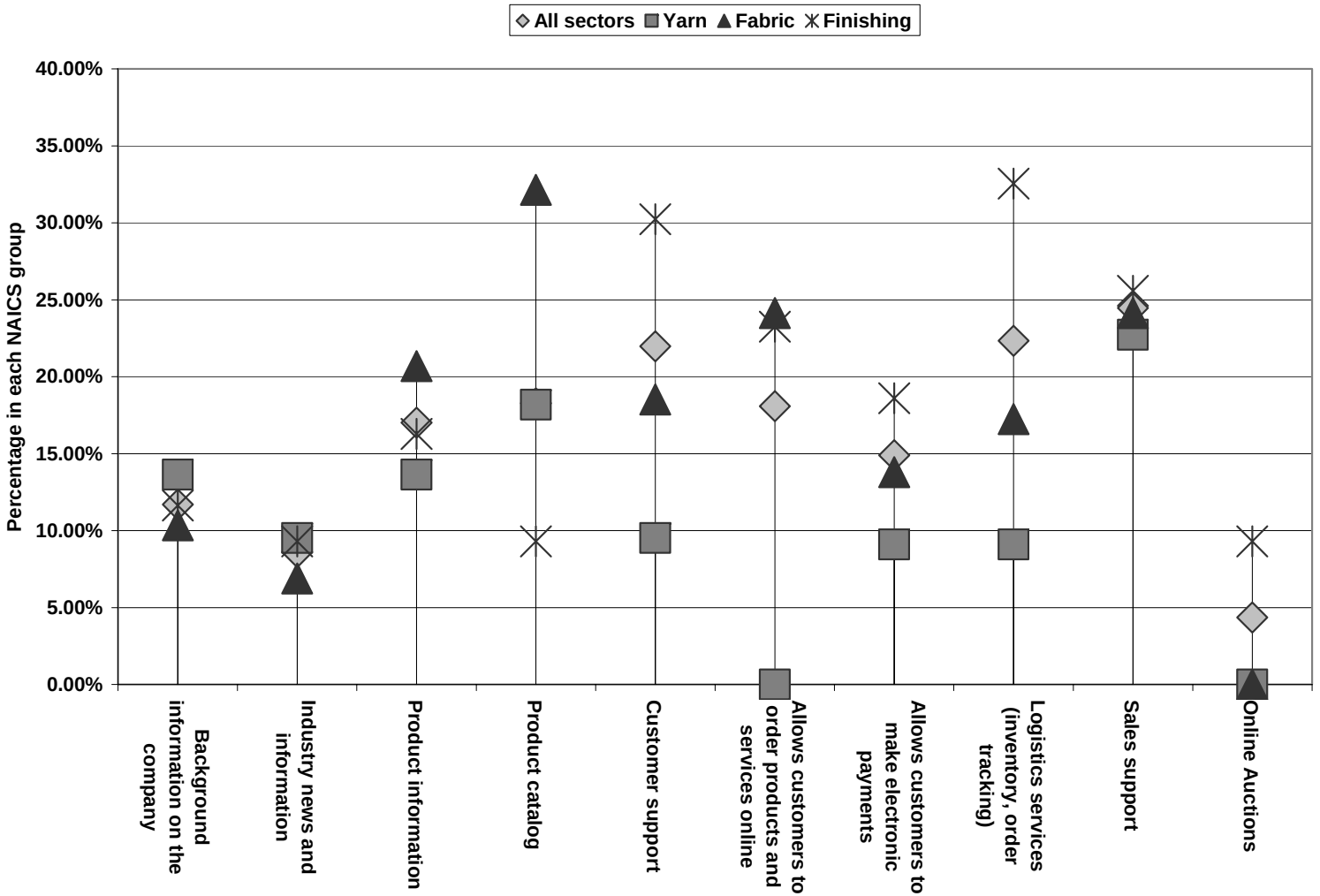

Figure 13: Q2 - Services planning to be offered on website by percentage of responses and NAICS group.

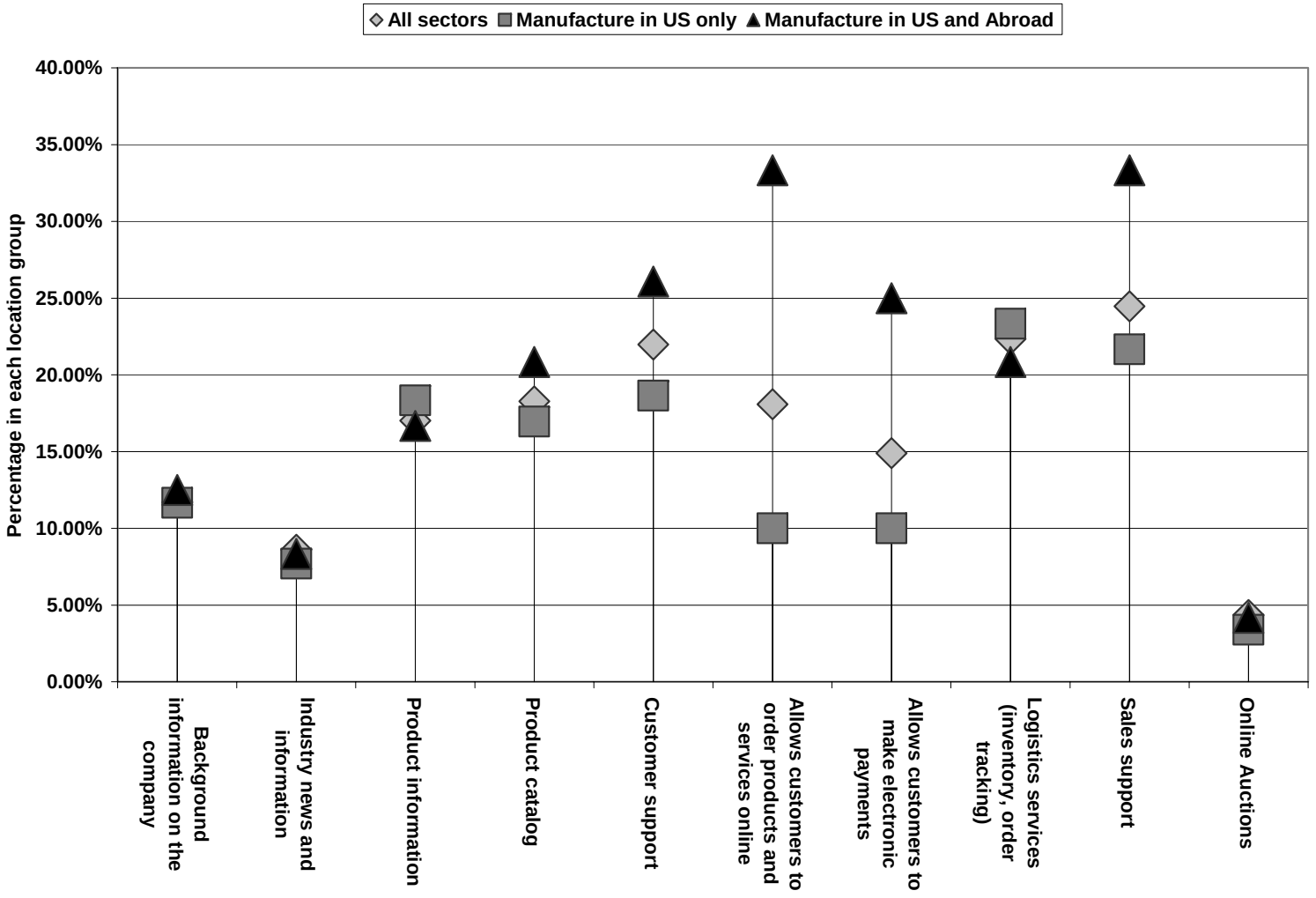

Figure 14: Q2 - Services planning to be offered on website by percentage of responses and manufacturing location group.

According to the survey responses from question three on the questionnaire, the following business activities were chosen by the largest number of respondents as those that they are planning to begin facilitating through electronic means (see Figure 15):

1. *Sell goods internationally*; seventeen respondents plan to adopt this in the next 5 years, 2 plan to do so in the next 6 months.
2. *Manage capacity or inventories*; thirteen respondents plan to adopt this in the next 5 years, 2 plan to do so in the next 6 months.
3. *Sell goods domestically*; thirteen respondents plan to adopt this in the next 5 years, 1 plans to do so in the next 6 months.

Figure 16 shows how the responses to question 3 differ between micro, small, medium, and large companies. The largest percent of micro, small, and medium sized companies are planning to use electronic means to sell *goods internationally* while the largest percentage of large companies are planning to *manage capacity or inventories* via electronic means.

Figure 17 shows the differences in percentage of responses for question 3 between the NAICS groups. A much greater percentage of finishing companies are planning to *purchase direct production goods and purchase MRO goods* with the help of online technologies than those in the yarn and fabric sectors.

Figure 18 shows that a greater percentage of companies with some manufacturing facilities abroad are planning to use online technologies to facilitate all of the business activities mentioned with the exception of *managing customer relationships* and *managing supplier relationships*. A greater percentage of domestic manufacturers are

planning to *manage their relationships* with their *customers* and *suppliers* with the help of online technologies.

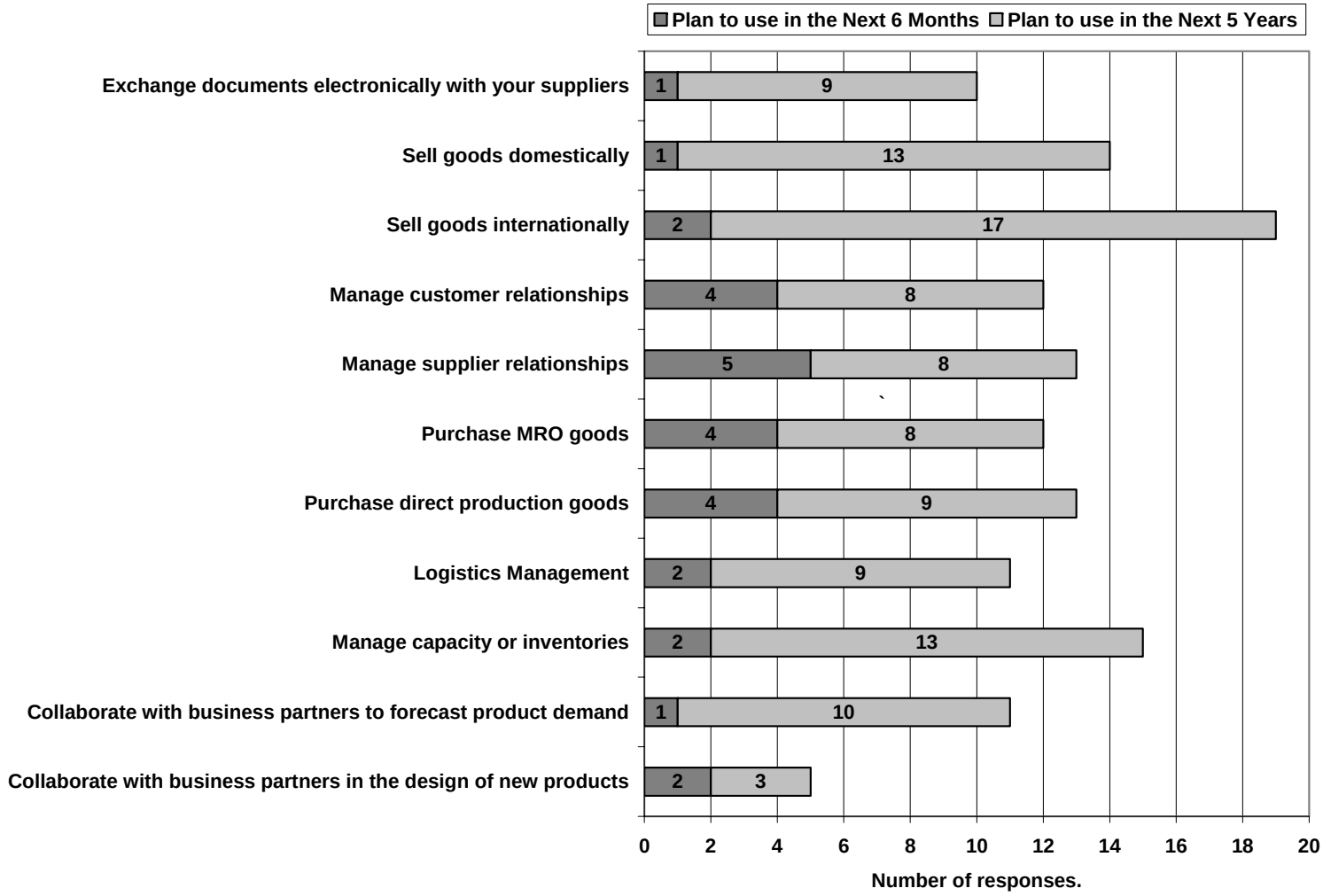

Figure 15: Q3 - Business activities planning to be facilitated via electronic means.

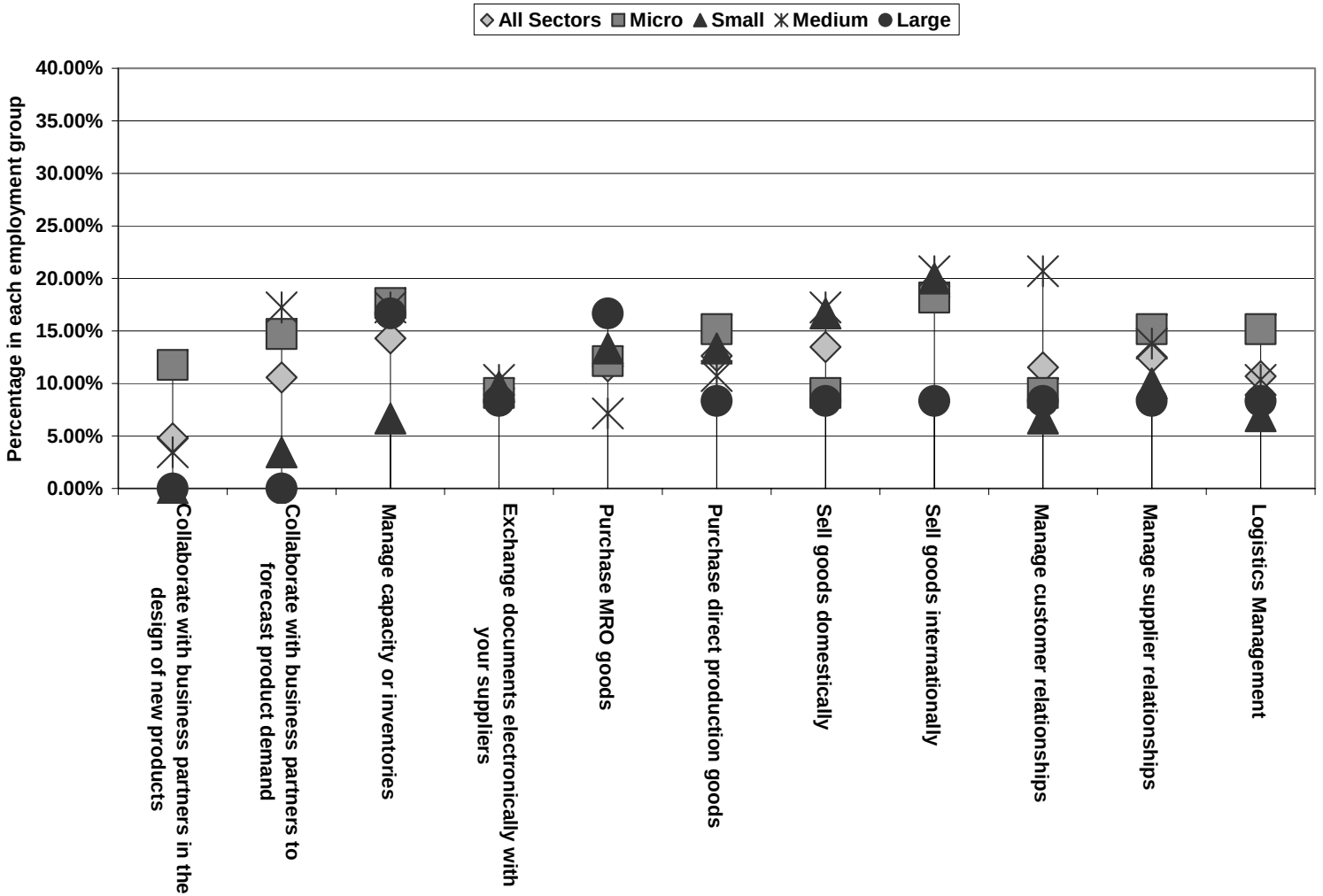

Figure 16: Q3 - Business activities planning to be facilitated by online technologies by percentage of responses and by employment group.

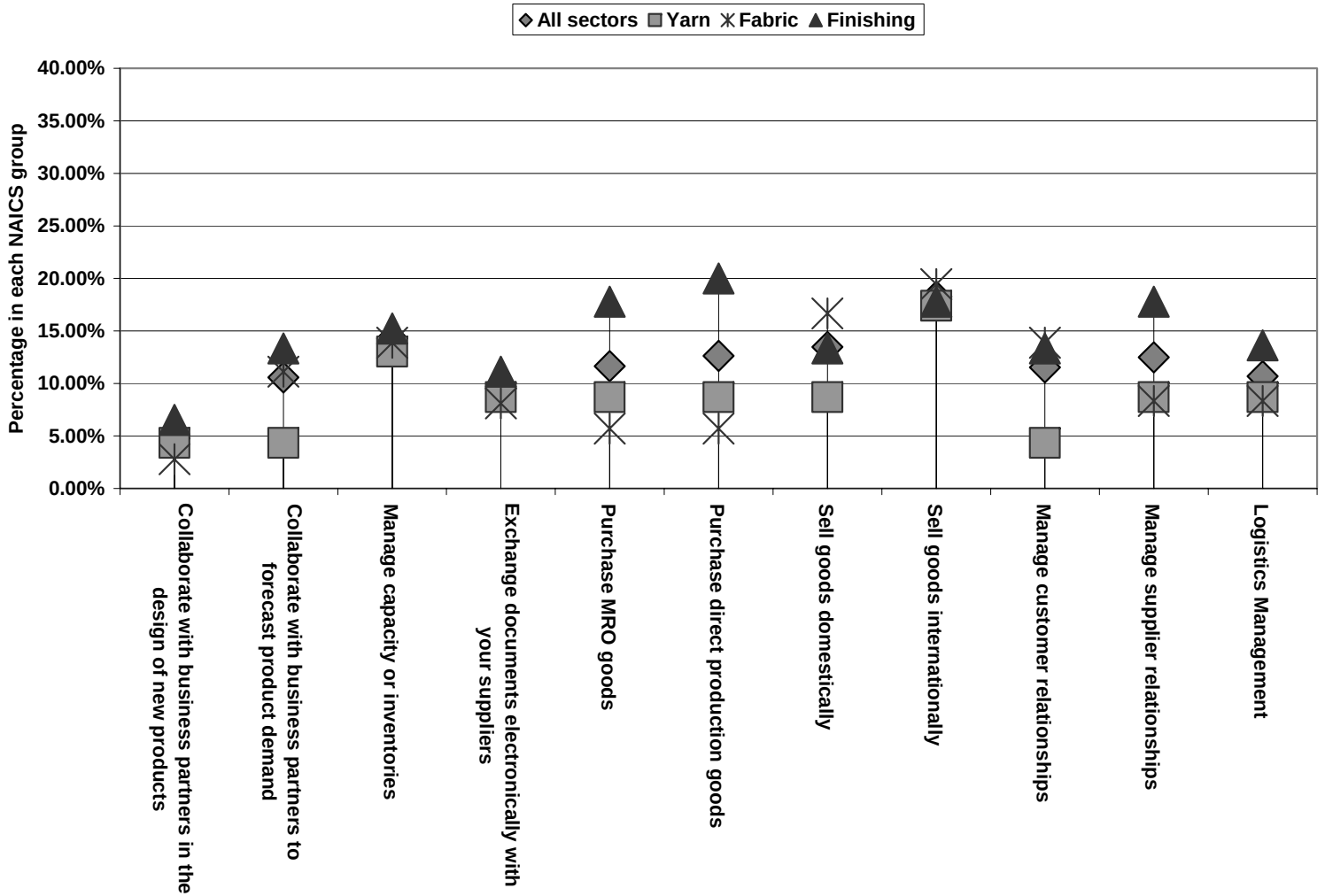

Figure 17: Q3 - Business activities planning to be facilitated by online technologies by percentage of responses and by NAICS group.

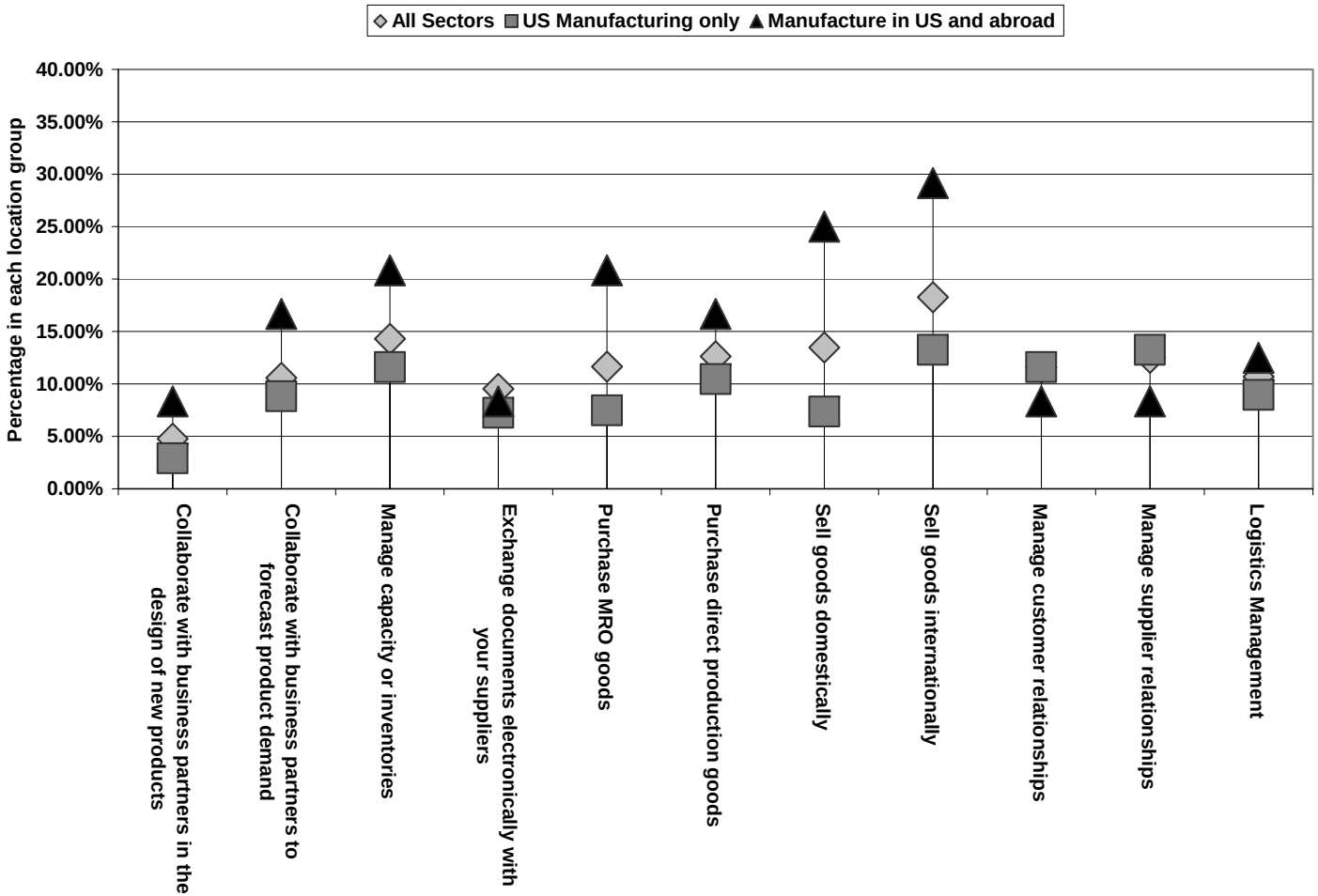

Figure 18: Q3 - Business activities planning to be facilitated by online technologies by percentage of responses and by manufacturing location group.

RO3: Identify benefits to the adoption of e-business initiatives

According to the responses to question four from the survey, respondents have seen the greatest positive effects on the following business areas due to the use of e-business:

1. *Access to information*; 56.8% of the respondents saw a positive effect in this area.
2. *Communication with customers and suppliers*; 53.9% of the respondents saw a positive effect in this area.
3. *Time savings*; 40.8% of the respondents saw a positive effect in this area.
4. *Meeting the demands of the customer*; 40.2% of the respondents saw a positive effect in this area.

Figure 19 shows a histogram of the number of respondents indicating a positive effect on the business activities listed in question 4.

Figure 20 shows the differences between micro, small, medium, and large companies in relation to the positive effects their companies have seen through the use of e-business. A greater percentage of the large companies have seen a positive effect from e-business. In fact, approximately 83% of the large companies have seen a positive effect on *time savings* and about 75% have seen a positive effect on the *efficiency of the company's internal business processes*. Large companies see less of a positive effect than do the small, medium and micro companies in the *offer of products and services*. Also, a greater percentage of the micro companies see a positive effect on the *volume of the company's sales* and on the *number of customers*.

Figure 21 illustrates the differences in the positive effects seen with the use of e-business between yarn, fabric, and finishing companies. In general, a greater percentage

of yarn manufacturers are seeing positive effects from e-business and a smaller percentage of fabric manufacturers are reporting a positive effect. The finishing companies seem to be in the middle with the exception of the *number of customers* and the *volume of the company's sales*, where a greater percentage of the finishing companies see a positive effect.

Figure 22 shows how the positive effects of e-business differ between companies with manufacturing in the US only and those who also manufacture abroad. A smaller percentage of the companies that have manufacturing facilities abroad see positive effects from e-business.

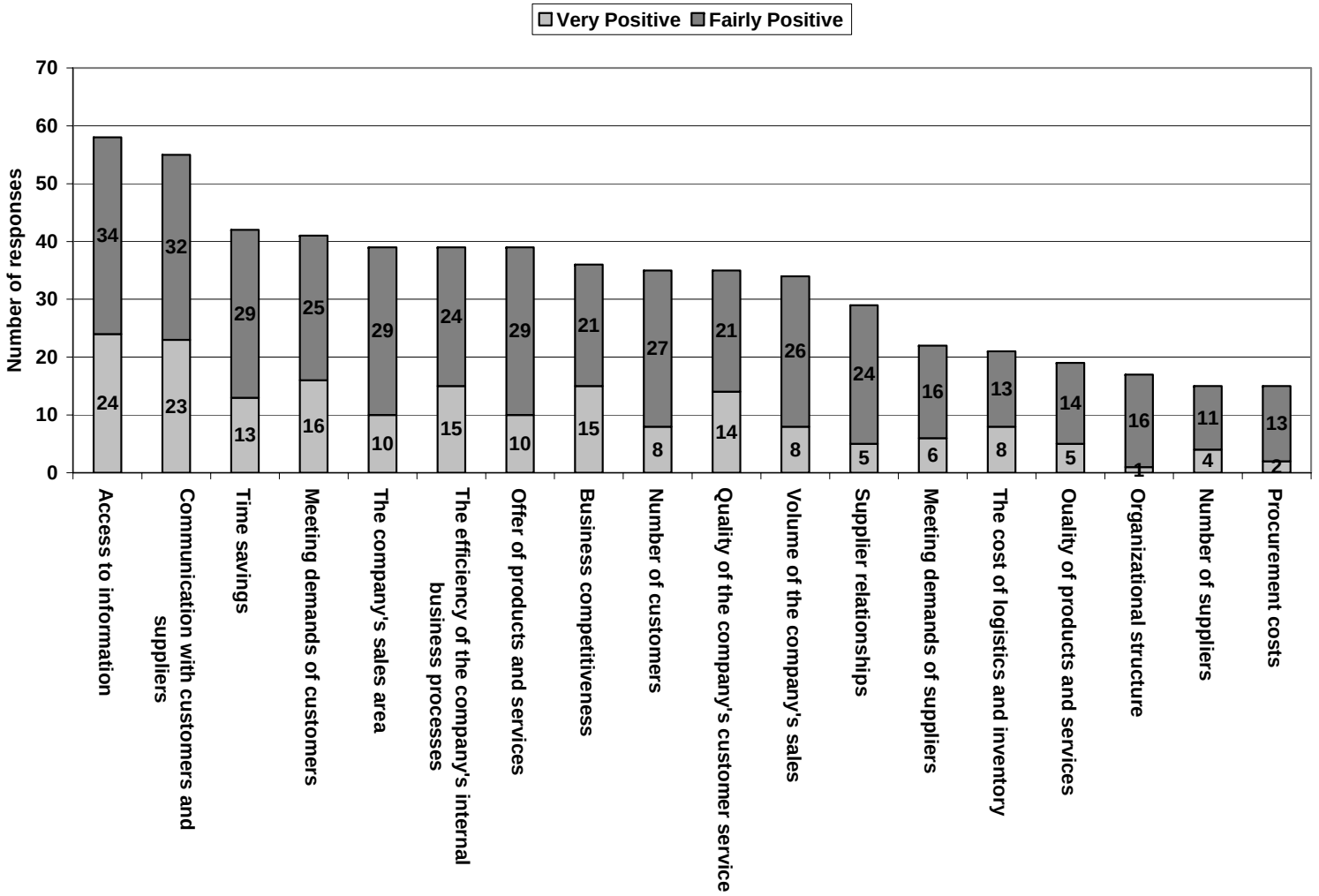

Figure 19: Q4 – Business activities that have been positively affected by the use of e-business

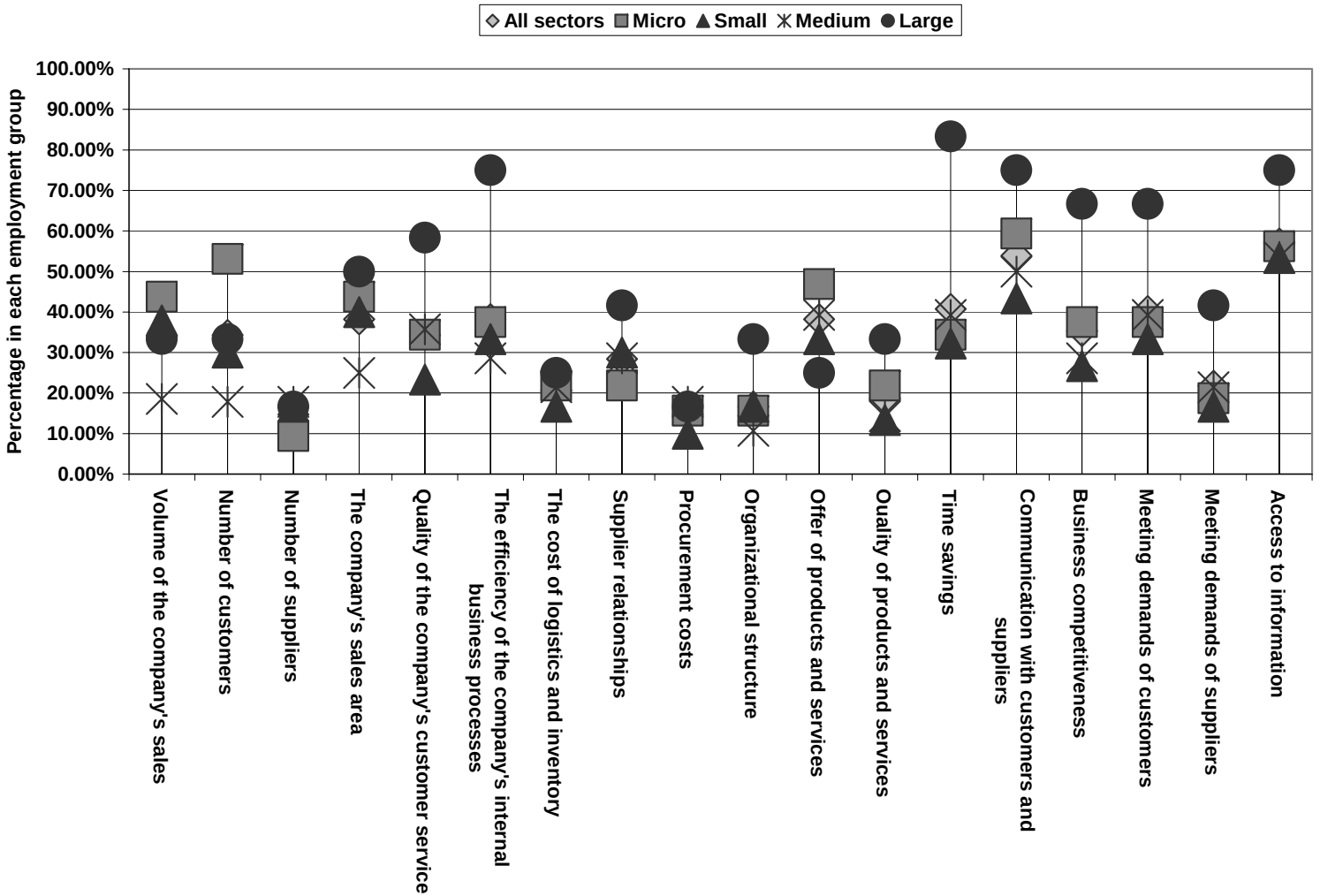

Figure 20: Q4 - Business activities that have been positively affected by the use of e-business by employment group.

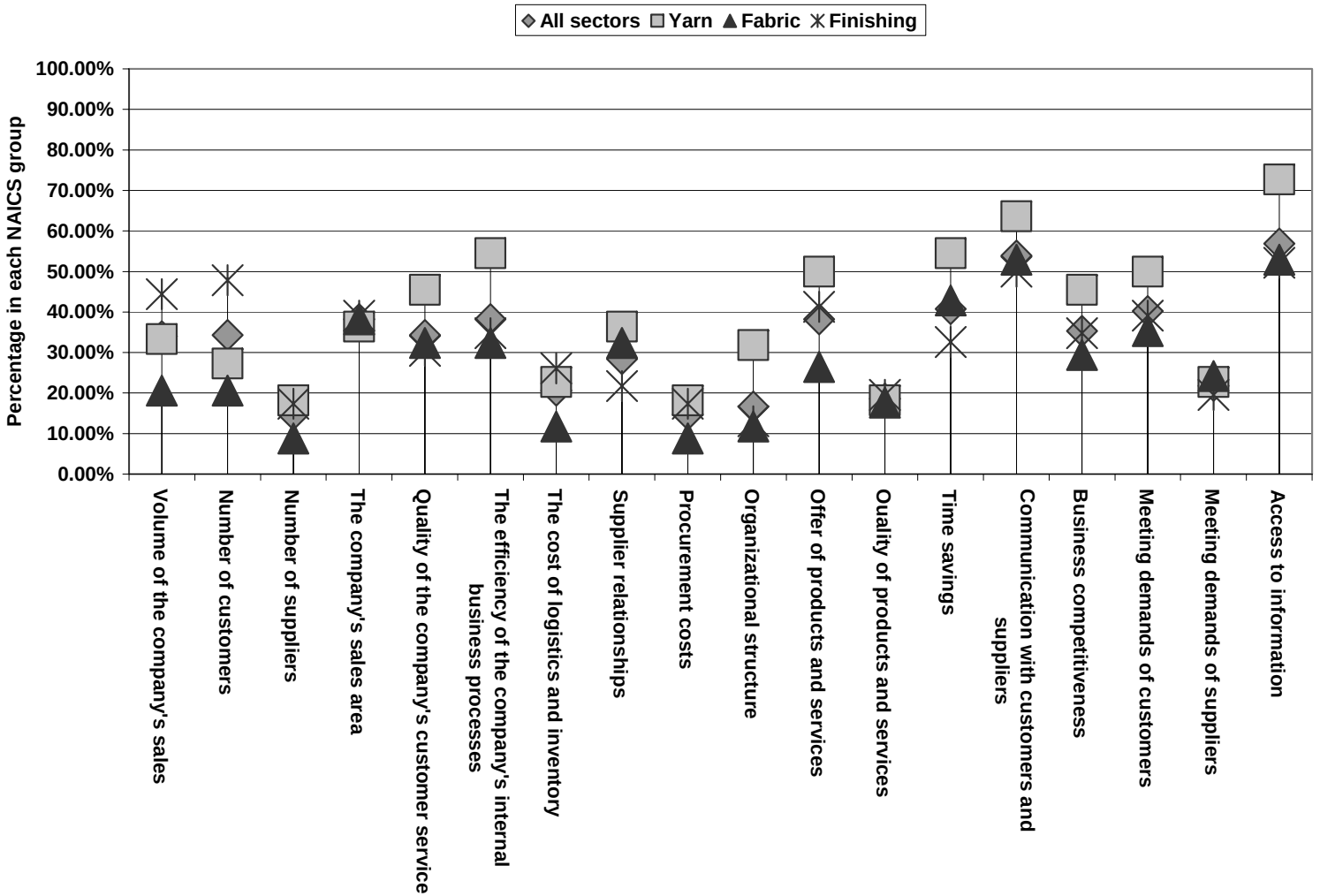

Figure 21: Q4 - Business activities that have been positively affected by the use of e-business by NAICS group

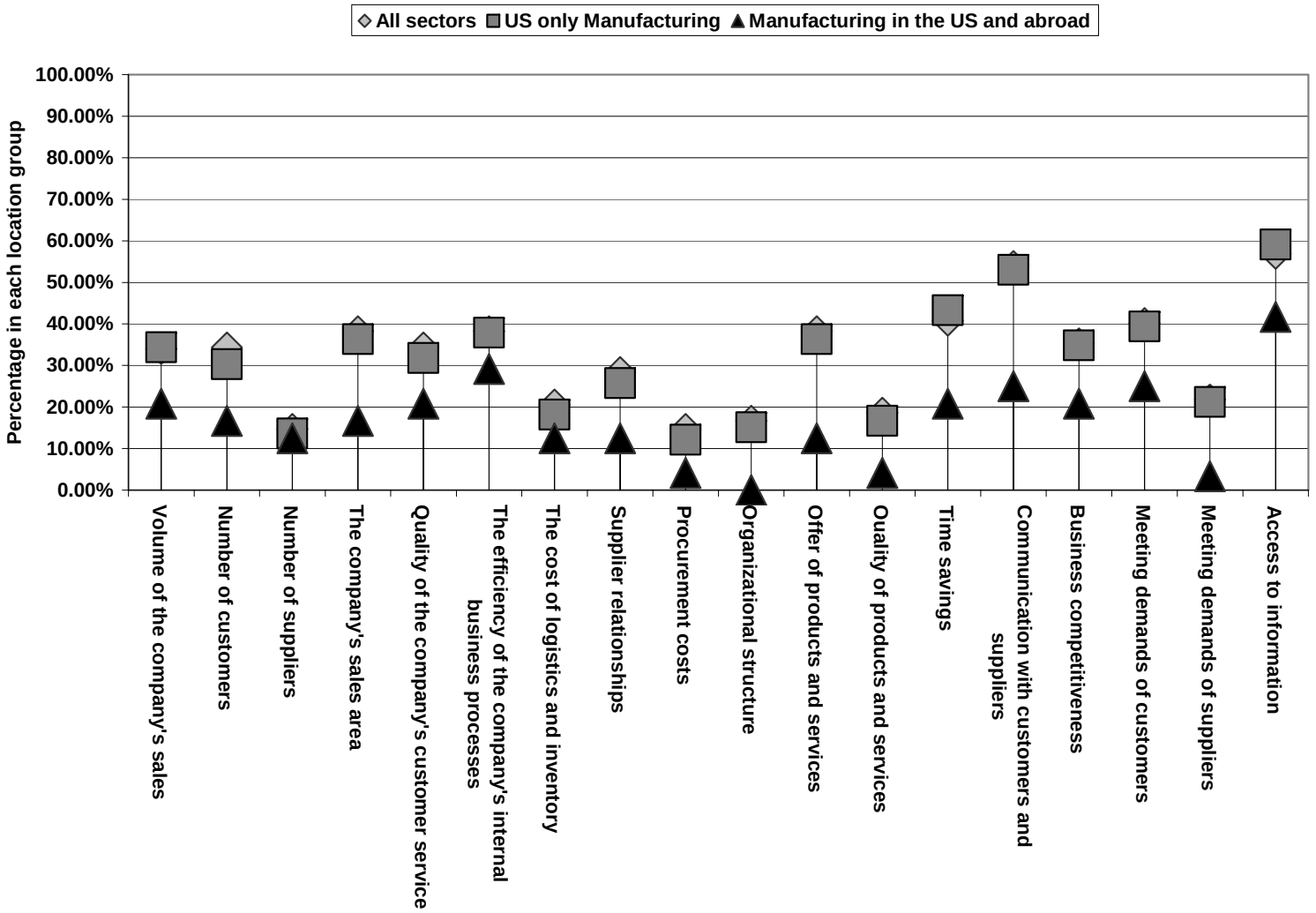

Figure 22: Q4 - Business activities that have been positively affected by the use of e-business by manufacturing location group.

Question 6 from the survey asked respondents to report the benefits gained from their e-business activities. The top three reported benefits gained from respondent's e-business activities were (see Figure 23):

1. Forty-nine respondents reported *achieving improved communication with customers or suppliers*,
2. Forty-eight respondents reported gaining *better access to information*, and
3. Thirty-seven respondents reported an *increased responsiveness to customers*.

Figure 24 shows how the benefits gained from e-business activities vary by company size. A greater percentage of large companies saw benefits from e-business activities. The only benefits that were seen by a greater percentage of the other groups were *increased market share* by the micro companies and *improved quality of products and services* by the micro, small, and medium groups.

Figure 25 illustrates how the benefits gained from e-business activities differ between yarn, fabric, and finishing companies. In general, a greater percentage of the yarn companies reported experiencing benefits from e-business activities. The only exception is *improved communication with staff* which was reported as a benefit gained by a larger percentage of fabric companies.

Figure 26 shows how companies who manufacture in the US only differ from those who also have manufacturing facilities abroad in the benefits they have experienced from e-business activities. A greater percentage of the US only manufacturers reported seeing the following benefits than did those with manufacturing operations abroad: 1) *more competitive organization*, 2) *improved delivery time to customer*, 3) *increased market share*, and 4) *improved quality of products and services*.

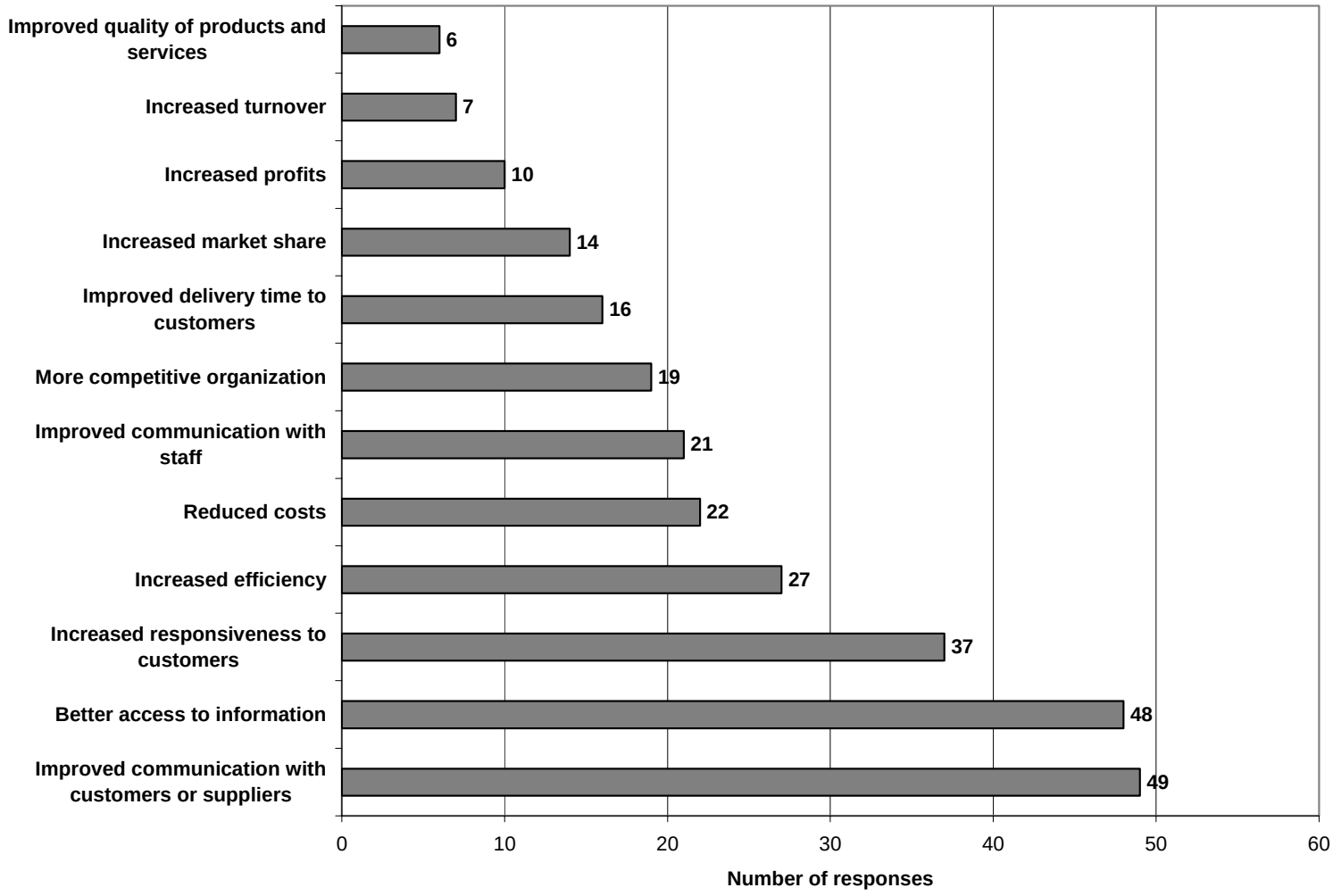

Figure 23: Q6 - Benefits gained from e-business activities.

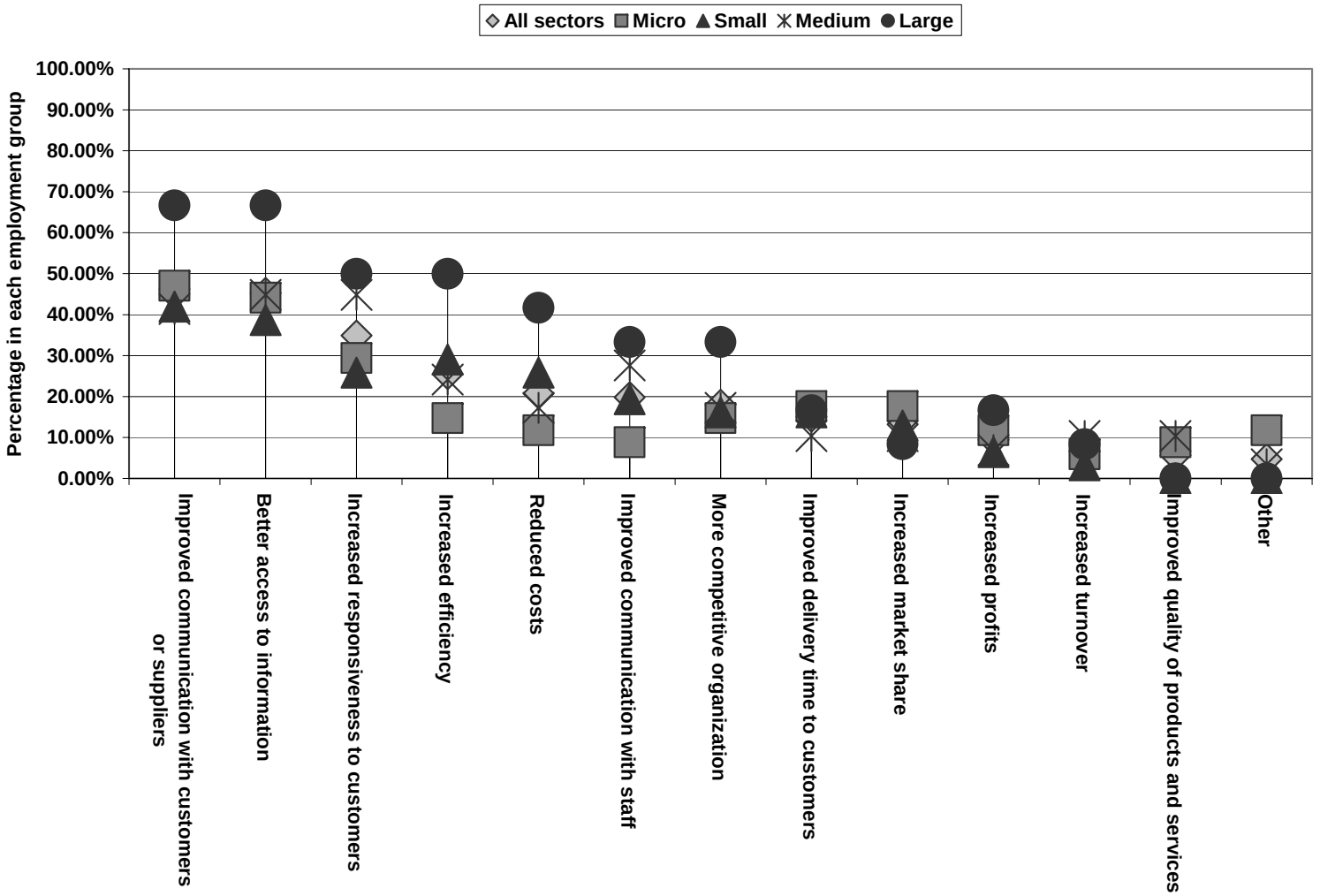

Figure 24: Q6 - Benefits gained from e-business activities by employment group.

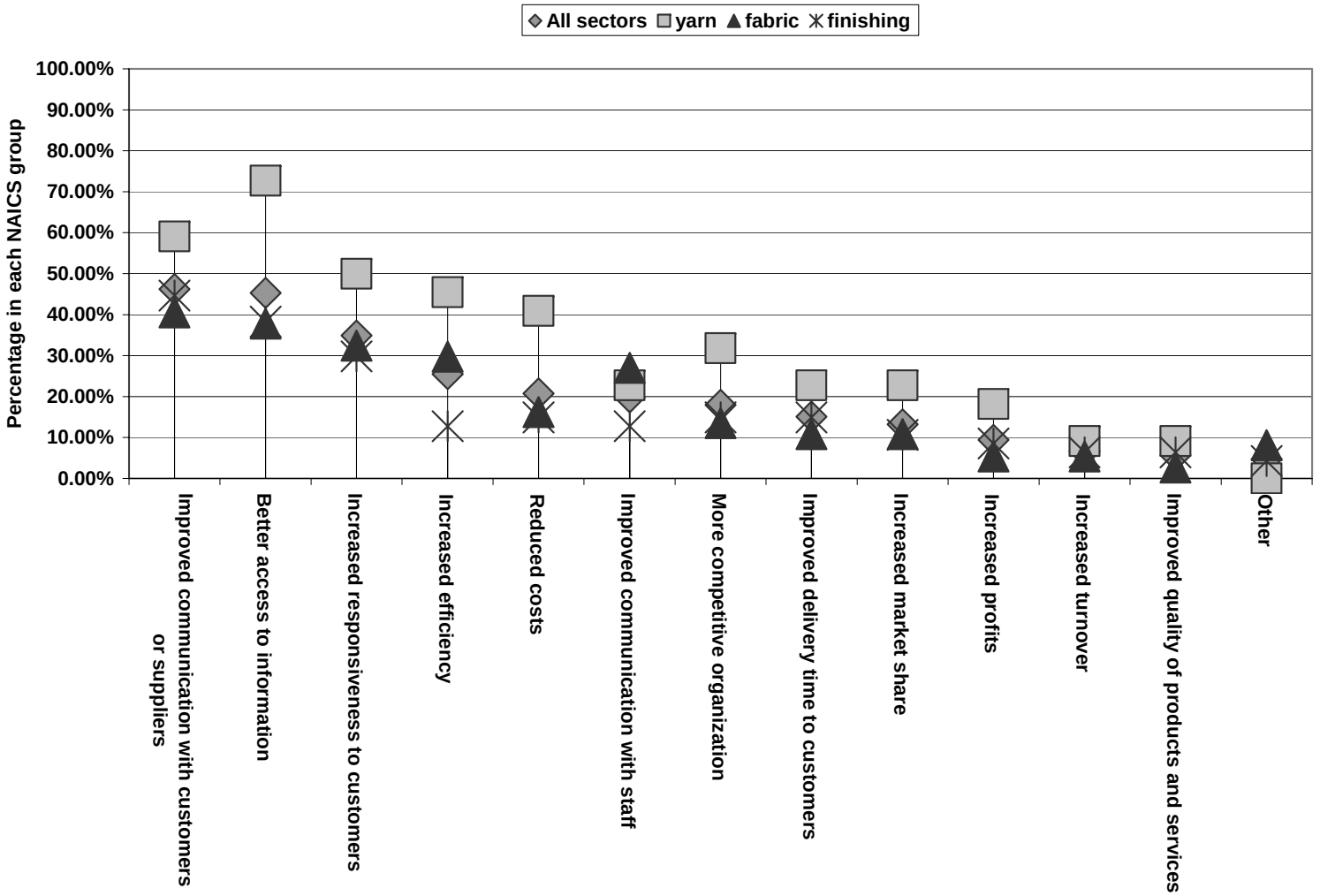

Figure 25: Q6 - Benefits gained from e-business activities by NAICS group.

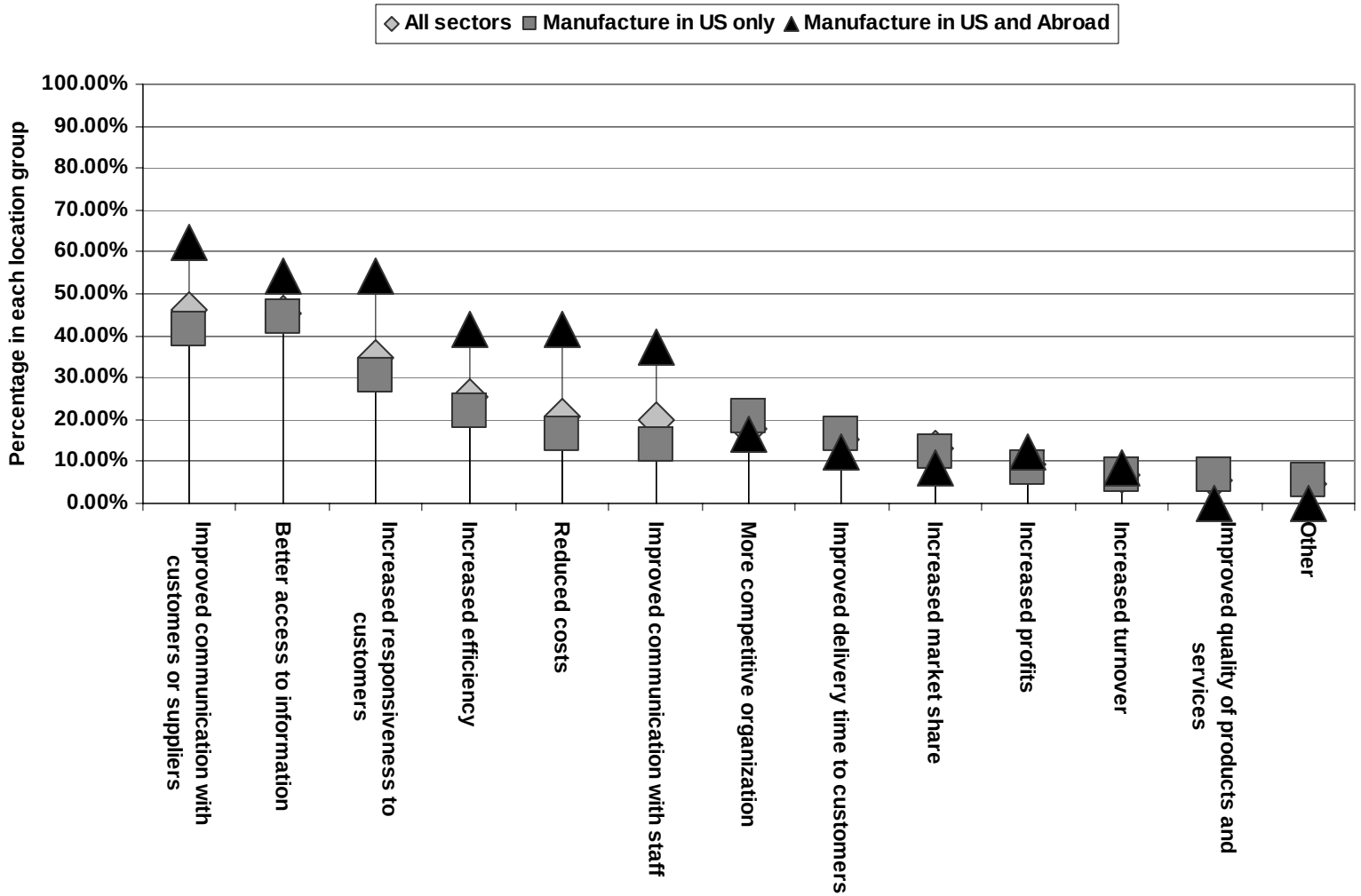

Figure 26: Q6 - Benefits gained from e-business activities by manufacturing location group.

RO4: Identify barriers to the adoption of e-business initiatives

Question 7 asks respondents to identify barriers to implementing an e-business solution. The most frequently chosen barriers were (see Figure 27):

1. Forty-eight respondents saw *security issues* as a barrier,
2. Forty-two respondents saw the *lack of skilled staff* as a barrier, and
3. Thirty-seven respondents saw *time constraints* as a barrier to the adoption of e-business.

Figure 28 compares the barriers perceived by micro, small, medium, and large companies. A greater percentage of the micro companies see *initial cost is too high* as a barrier as compared to small, medium and large companies. A greater percentage of medium companies view *security issues*, *lack of skilled staff*, and *readiness of business partners* as barriers than do micro, small and large companies. *Data protection and privacy issues* seem to be viewed as more of a barrier to large companies than smaller companies.

Figure 29 compares the barriers perceived by yarn, fabric, and finishing companies. A greater percentage of yarn companies see *security issues* as a barrier to e-business.

Figure 30 shows the differences between what companies with manufacturing in the US only view as barriers to e-business and those companies with manufacturing facilities abroad. Those with manufacturing abroad reported *security issues*, *readiness of business partners* and *initial cost is too high* most often as barriers. Those with manufacturing in the US only reported *lack of shared technical standards*, *time constraints* and *initial cost is too high* most often as barriers.

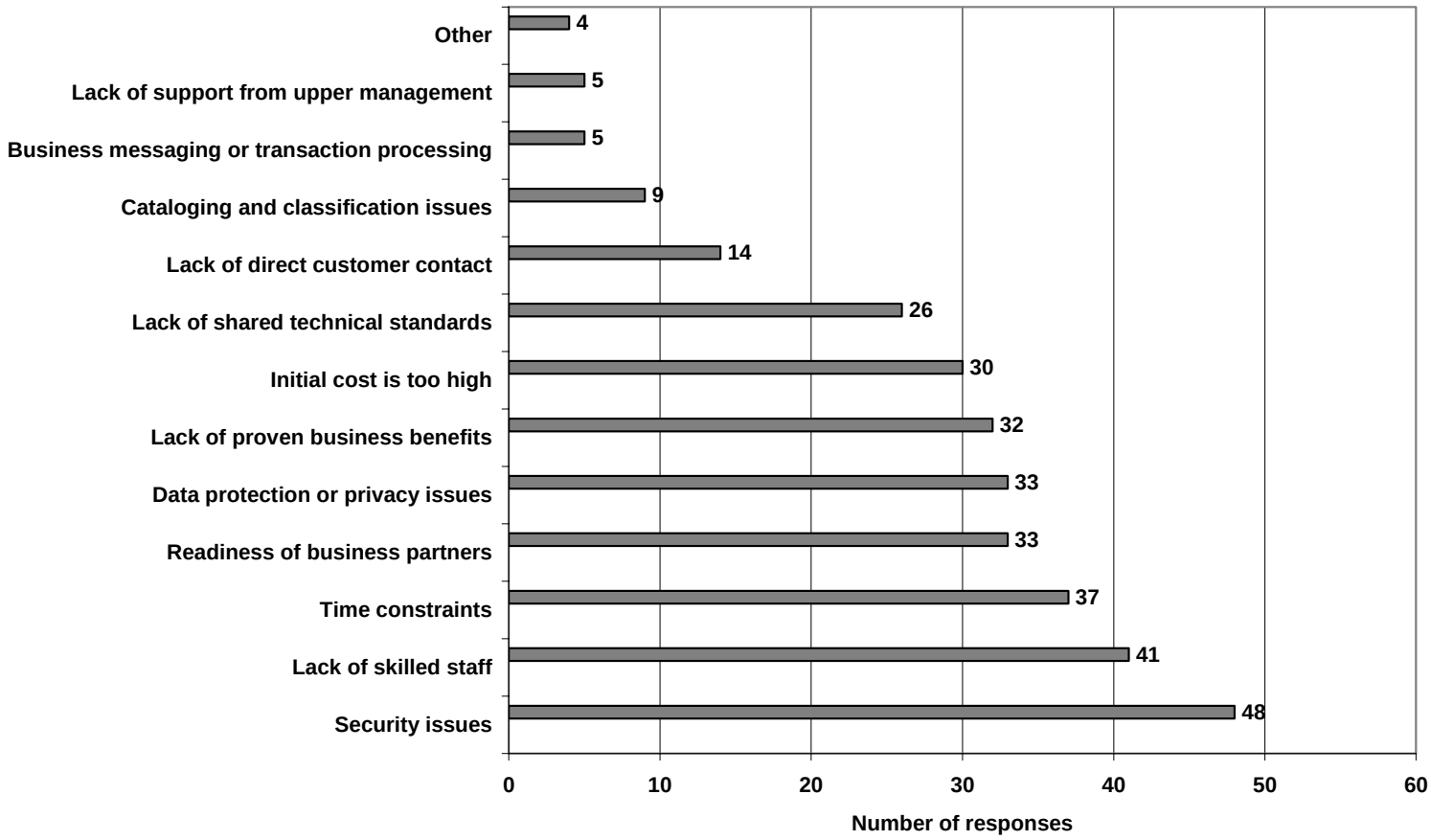

Figure 27: Q7 – Barriers to the adoption of e-business.

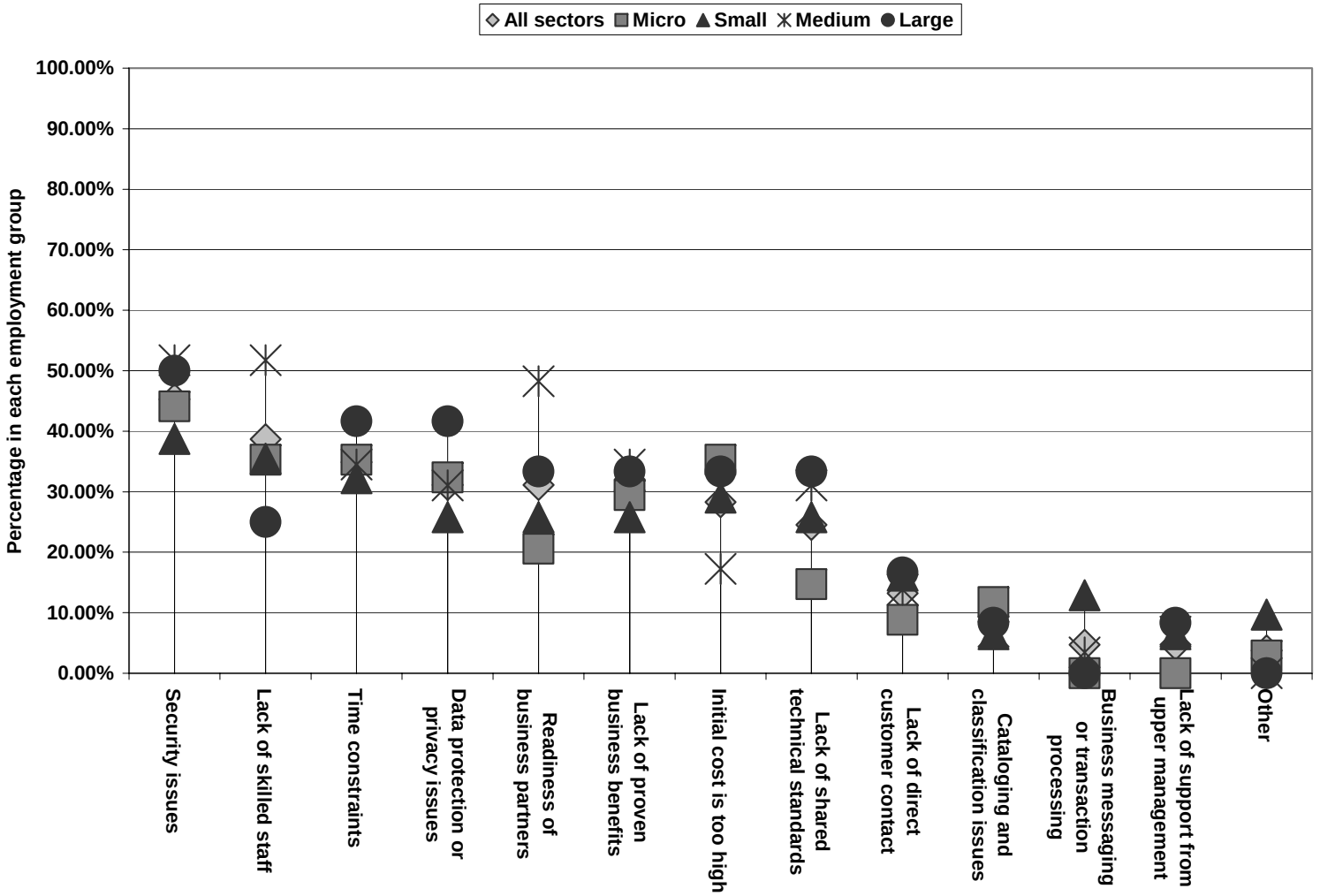

Figure 28: Q7 – Barriers to the adoption of e-business by employment group.

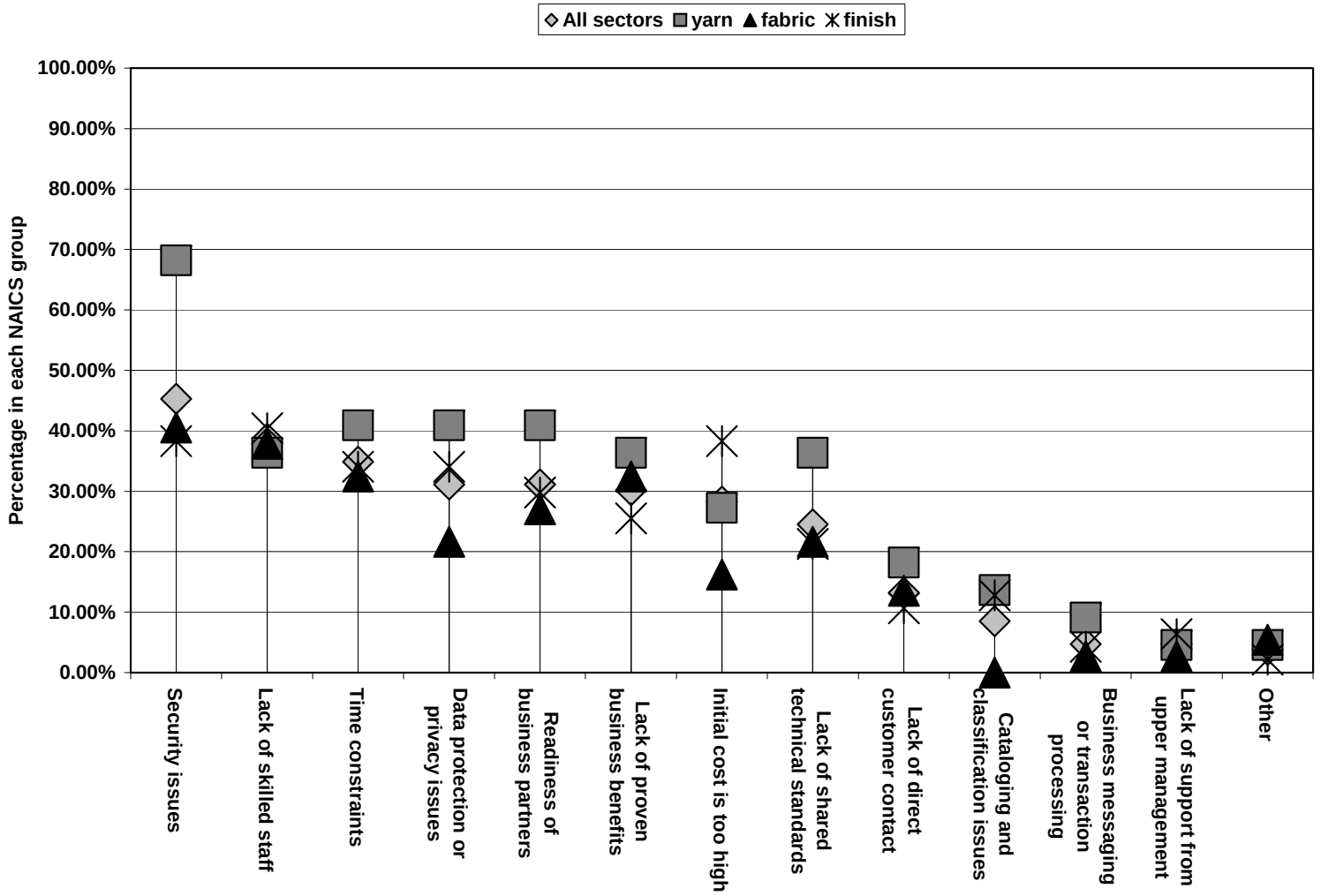

Figure 29: Q7 – Barriers to the adoption of e-business by NAICS group.

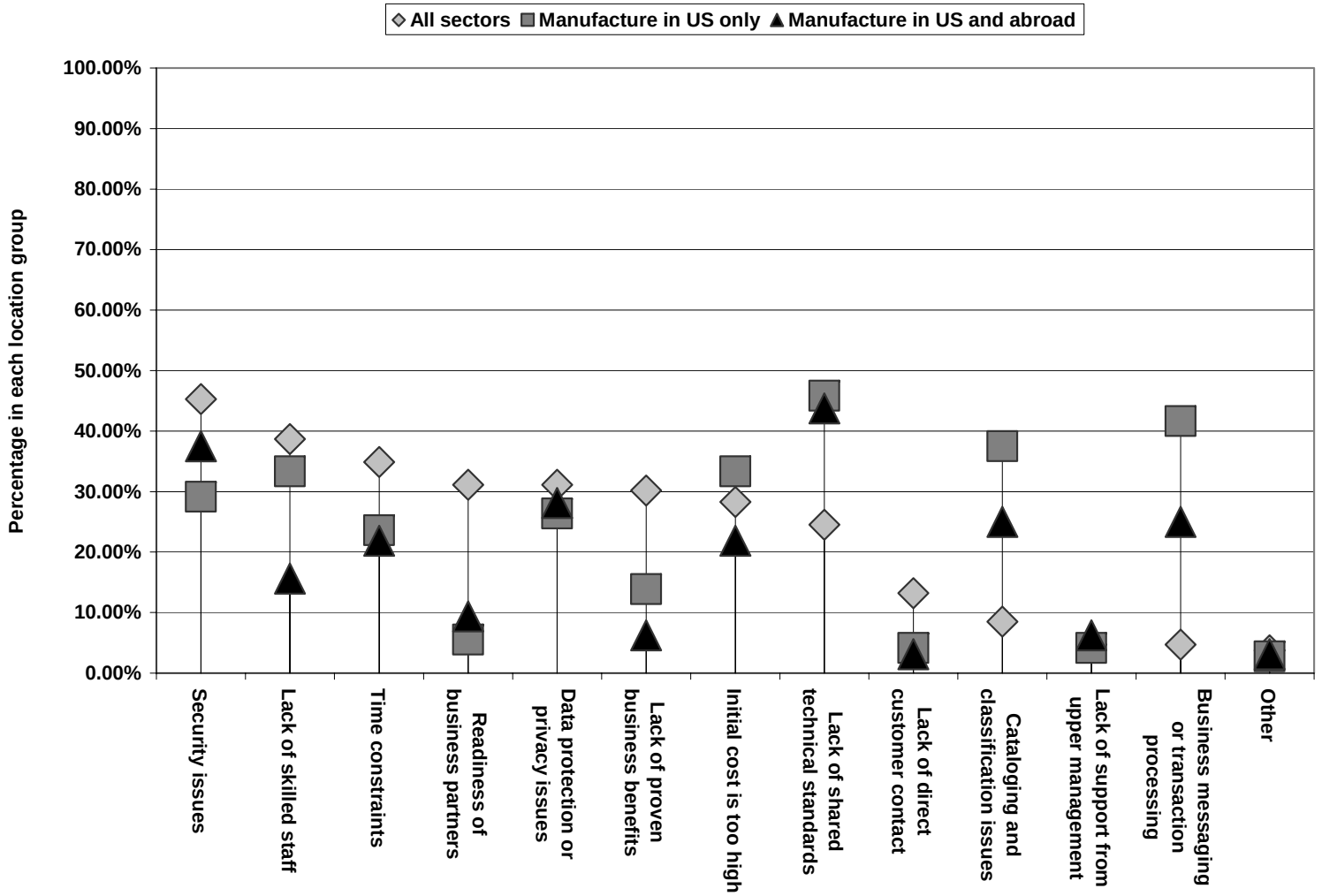

Figure 30: Q7 – Barriers to the adoption of e-business by manufacturing location group.

RO5: Determine which e-business initiatives textile manufacturers deem to be most important for achieving a more competitive strategy

Customer relationship management is the number one response with 50 respondents expecting to see benefits in the near future. Information exchange was the second highest response, with 48 respondents expecting to see benefits in the near future. All other choices for question 5 were chosen by 16-22 respondents, a far second. Figure 31 shows how these were distributed.

Figure 32 shows how micro, small, medium, and large companies differ in their expectations for what the greatest benefits from e-business will be in the near future. A greater percentage of large companies expect *supply chain management* to be the greatest benefit of e-business than do micro, small, and medium companies. A greater percentage of the medium companies responded that they expect *logistics management* to be the greatest benefit than did the other employment groups.

Figure 33 shows how yarn, fabric, and finishing companies differ in their expectations for the greatest areas of benefit from e-business. A greater percentage of the yarn companies expect *supply chain management* to be the biggest area benefiting from e-business in the near future.

Figure 34 illustrates the differences in the areas of greatest expected benefit from e-business in the near future. The greatest percentage of companies that have manufacturing facilities abroad expect customer relationship management, followed by information exchange and then logistics management to be the areas receiving the most benefits from e-business in the future.

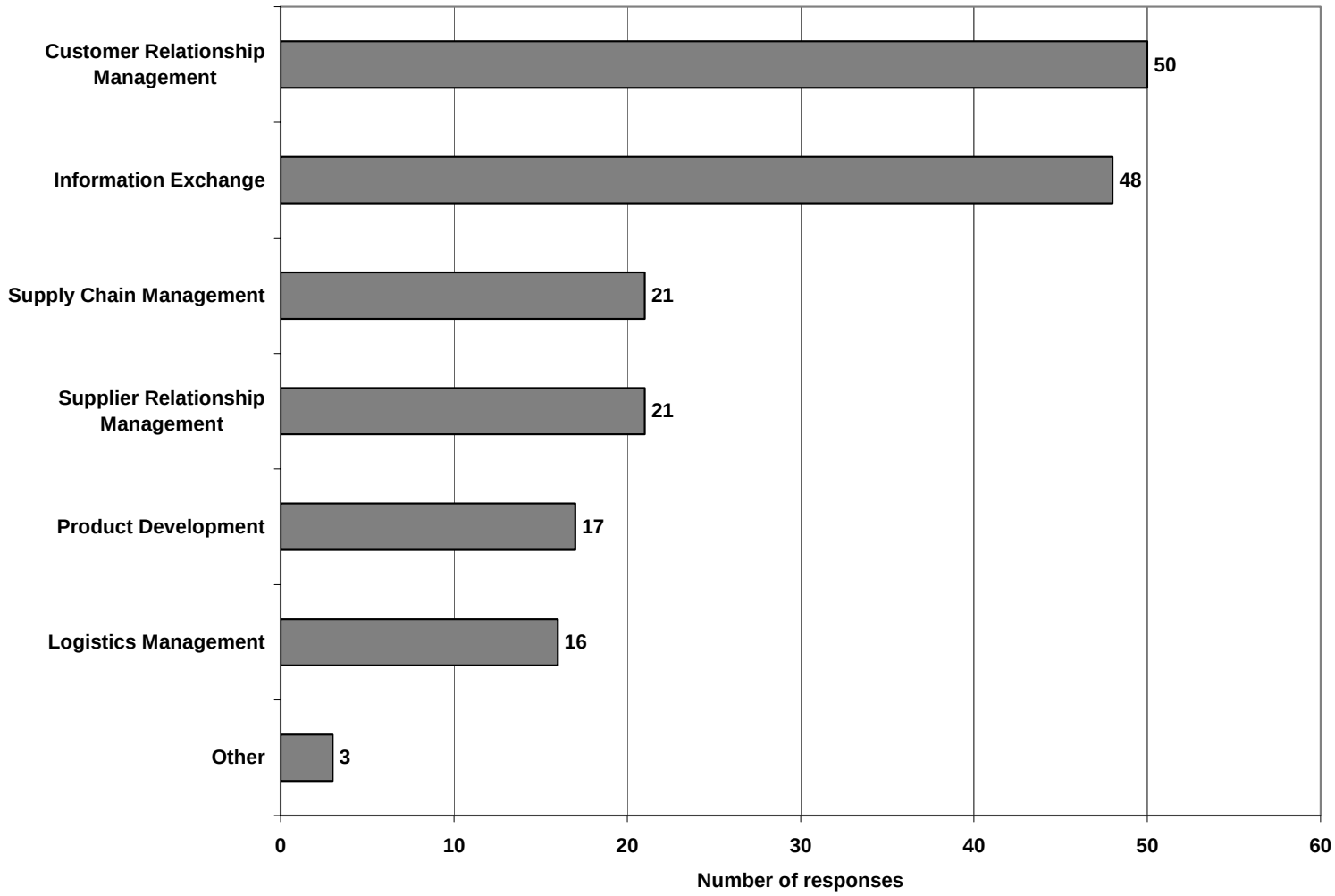

Figure 31: Q5 – Expected benefits from e-business in the near future.

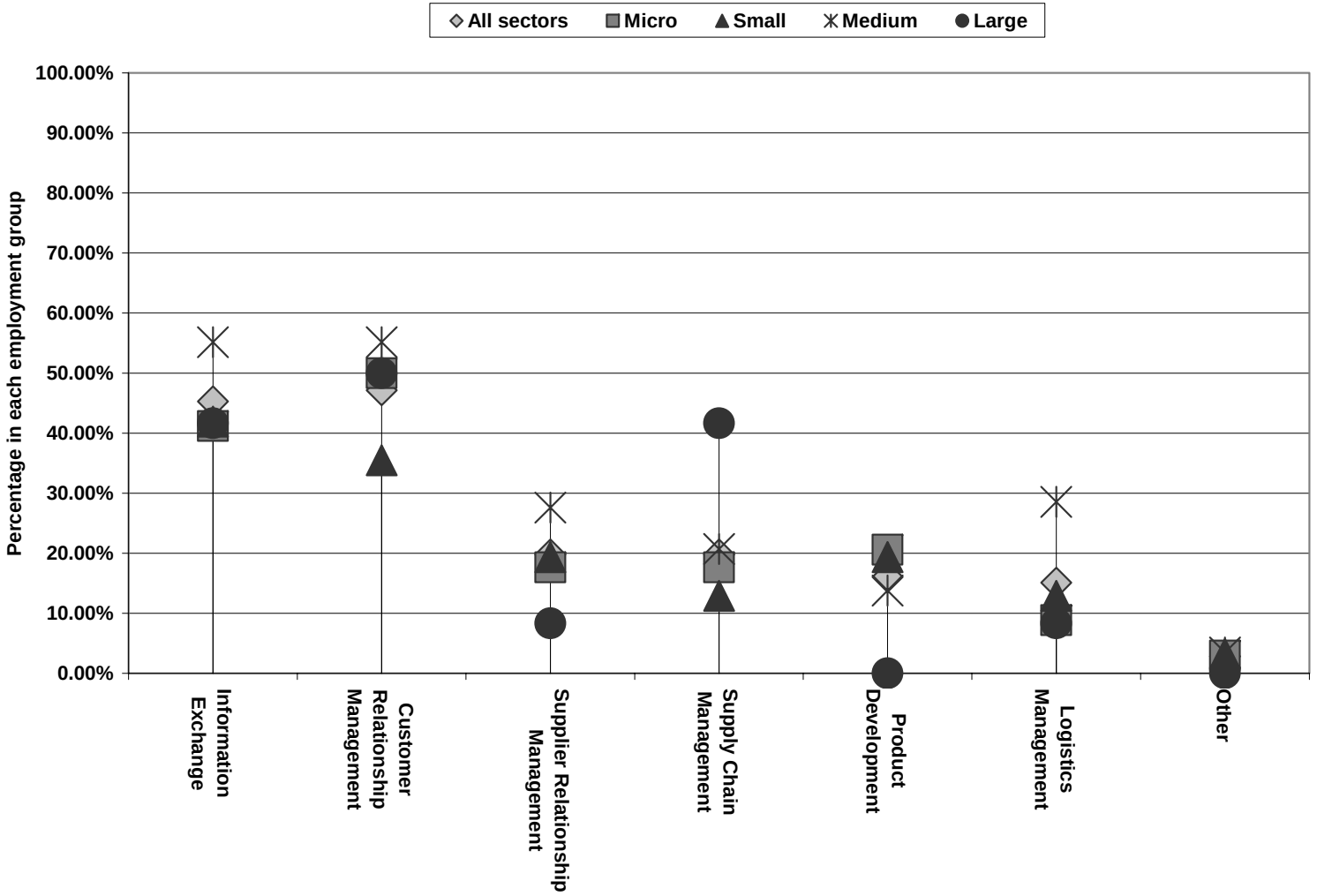

Figure 32: Q5 – Expected benefits from e-business in the near future by employment group.

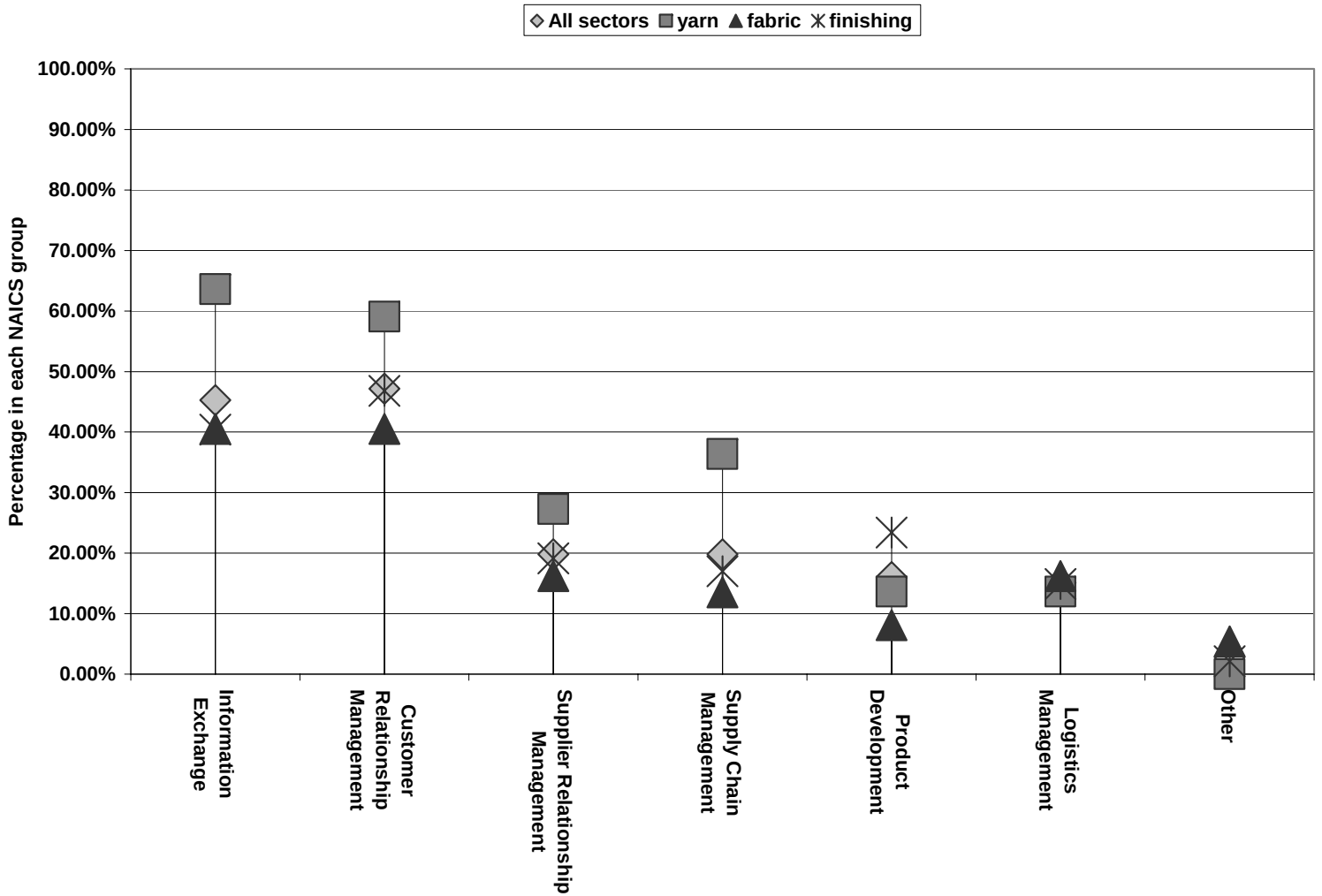

Figure 33: Q5 – Expected benefits from e-business in the near future by NAICS group.

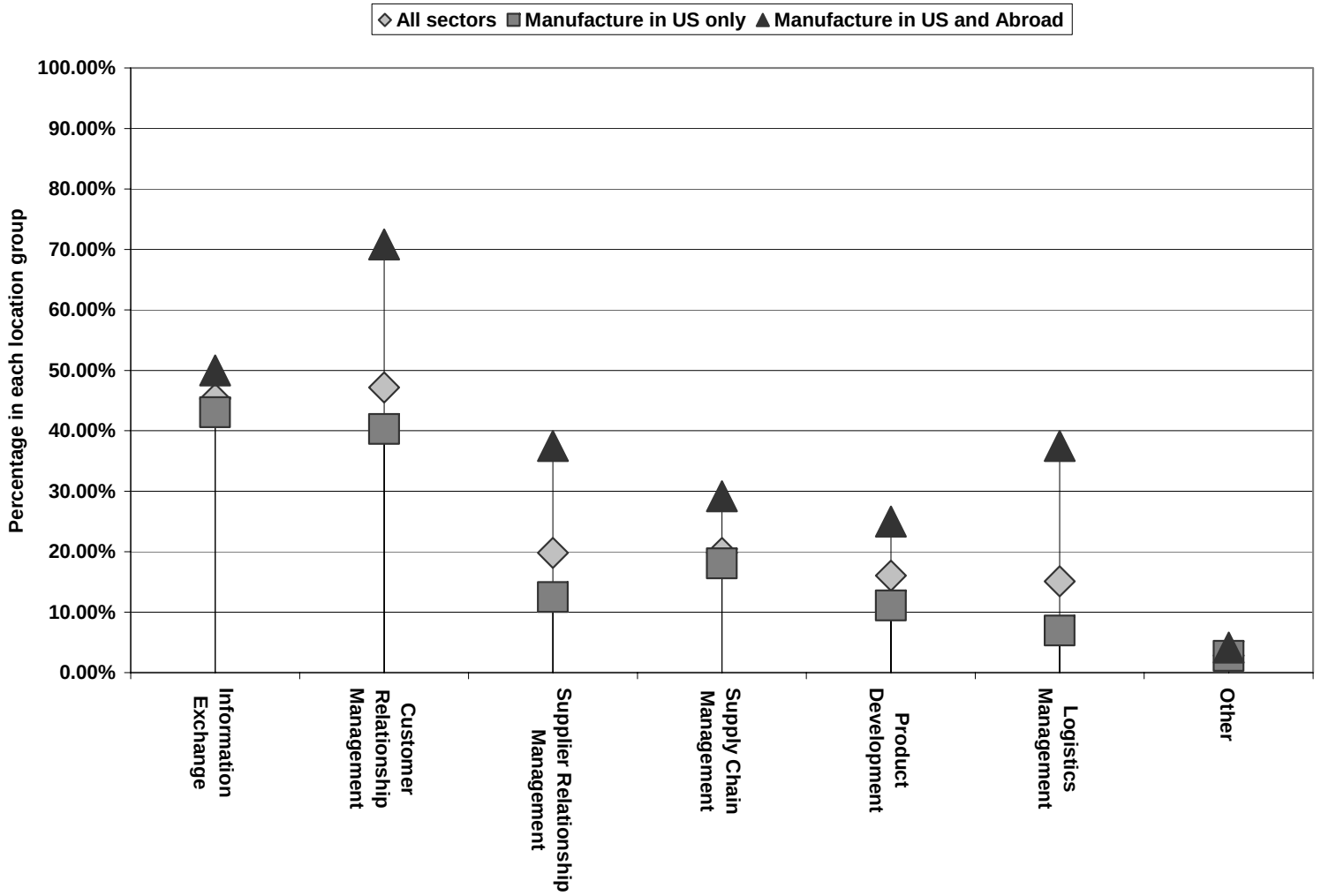

Figure 34: Q5 – Expected benefits from e-business in the near future by manufacturing location group.

Phase II-B Case Studies

Sample Description

A total of 9 companies were visited in the timeframe that lasted from November 15, 2005 to February 14, 2005. Of the mail surveys returned, 41 companies indicated that they would be interested in participating in further research. All companies that indicated an interest in participating were sent an email (see Appendix H). Six companies replied to the email and all were able to schedule an interview that met the timeframe requirement. The other 4 companies were contacted by other graduate students or through NCSU faculty connections. Companies were also selected from the population so that there is a sampling from the groupings listed in Table 6.

Data was collected from face-to-face interviews with 20 executives at 9 companies. Interviews were scheduled at a time and place convenient to the interviewer within the time frame specified for Phase II of the study. Secondary data about the company was collected prior to the interview from an Internet search. Table 13 shows a summary of the sample information, including the titles of the executives interviewed, the number of employees, and the primary NAICS code and description.

Table 13: Sample Description

Case	Contact Titles	Company Size	Primary NAICS Code	NAICS Description
A	Owner	Small	313111	Yarn Spinning Mills
B	VP Manufacturing	Large	313111	Yarn Spinning Mills
	Director of Customer Service Production, Planning &Purchasing			
	Technical Director			
C	Six-Sigma Manager	Large	313111	Yarn Spinning Mills
	Vice President			
	Senior Project Manager			
	Systems Manager			
D	VP Manufacturing	Large	313111	Yarn Spinning Mills
	Head of Sales			
	Head of IT			
	Head of Programming			
	Plant Manager			
E	Vice President	Large	313111	Yarn Spinning Mills
F	Owner	Medium	313210	Broadwoven Fabric Mills
G	President	Medium	313210	Broadwoven Fabric Mills
	VP of Sales			
H	Vice President	Large	313210	Broadwoven Fabric Mills
I	Controller	Large	313210	Broadwoven Fabric Mills
	VP Sales and Marketing			

Case Studies

Case 1: Company A

Company A is a small, family owned, niche business specializing in spinning yarn for use in manufacturing performance apparel. Their manufacturing process includes opening through spinning of air jet yarn. Their business is growing. They have more than doubled their capacity since the company was founded in the mid 1990's. They remain competitive by specializing in finer count polyester yarn that currently can not be produced in Asia. Therefore, they feel that it is important to be "invisible" so that Asian producers will not knock off their products. For this reason, they do not have a website

or participate in third party websites. They also feel that by remaining invisible, they are also protecting their customer from competitors who may try to copy their products. They find new customers through word-of-mouth, i.e. the end customer will tell the fabric producer where to find the yarn to produce the product. Most of their customers are located in the U.S.

Company A does not use e-business, with the exception of email for some communication within the company and with customers and suppliers. The executive interviewed admits that they need to do more with e-business, but says that adding equipment has been more important than becoming e-business enabled. He is also concerned about losing the personal contact with customers or becoming too complicated. They are a small company with one mill. Everything is done on paper. Orders are carried out to the mill and placed on the machine. Nothing is done electronically.

He feels that the biggest problem in the textile industry is communication. Customers and suppliers need to work together, but it is very difficult to get the customer to share information. The line of communication is also too long. There is a huge problem in getting the information from the person who knows what they need to the person who sends the order. He says the partnerships in Asia seem to be better and US companies need to learn from them. He also feels that they are too far removed from the retailer. They need to communicate two levels down the supply chain in order to convince the retailer of the benefits of using their product. Retail buyers can not seem to look beyond the price in order to get a better product. A summary of the results of this case study are included in Table 14.

Table 14: Company A Interview Results

	Interview Results
Biggest E-business Benefits	• They use little to no e-business and therefore have seen no benefits with the exception of improving communication through the use of email.
Biggest E-business Barriers	• The company is small and does not need a lot of e-business internally – they can just walk out to the plant. • Customers are not computer savvy and do not require the use of e-business. • Management and employees are not computer savvy. • They would rather spend money on new equipment.
Future use of e-business	• The executive interviewed said that he would like to become more e-business enabled, but does not have any plans to do so at the moment.
Website	• They do not have a website. They want to stay invisible so that competitors will not steal their product.
Internal systems	• NA
Documents Exchanged electronically	• They do not exchange any documents electronically.

Case 2: Company B

Company B is a large company in the commodity business, focusing on producing yarn for t-shirts, fleece, hosiery, and denim. They have a fairly small group of big customers that take most of their orders, but they also have a lot of small customers. Close to half of their business is exported, mostly to the CAFTA region.

They have a website and an ERP system. The website is not integrated with the ERP system, however. The website includes company information so that customers, suppliers, and potential employees can get to know the company. Maps to the plants are included. The site is in both English and Spanish. The hope is that it will help truck drivers to find the plants and will cut down on calls to customer service for directions. It is a problem, especially since many truck drivers do not speak English. Sales contacts, along with phone numbers, etc. are also included. There is a product inquiry form, credit

application, and a photo tour of the plants. They do not currently have the ability for customers to track shipments online. They discussed this feature, but decided not to include it.

E-business is especially important when communicating with customers and suppliers overseas. The executive interviewed perceives email as a better way to communicate with overseas companies, eliminating the problem associated with different time zones. They also use email to send documentation. The executive believes that email is more reliable than fax. Another aspect of email that he finds useful is the ability to send a document to multiple people at once. He also sees an advantage in using email rather than the telephone for communication because it takes less time, there is written documentation of the problem, and the issue can be resolved at a time that is convenient. A phone call takes all of the person's focus, even if it is not the most important task to be completed at the time.

They currently have no plan to integrate their website with their EDI system. The executive interviewed does not think that their system is robust enough. The software is "green screen" from the mid 1990's. The executive believes that the web interface is not necessary. "If you know how to use the menu-driven system, it is just as fast". Company B does not want a system that is too sophisticated. They want to make sure that the company is run by the people and not by the ERP system.

The advanced shipment notice is submitted to many customers electronically. The EDI system generates a PDF document that can then be emailed to the customer. Their EDI system can be configured to communicate with the customer's system by the company's IT department. Orders from two of Company B's business partners

electronically populate their EDI system automatically. This drastically cuts down on labor spent keying in orders.

The EDI system manages contracts, orders, inventory and plan for production. It does not interface in real time with the plant floor. It keeps track of the inventory and bar code label information, but does not integrate with the machines on the plant floor. He believes that it is not worth the time and expense to have a fully integrated system. They run such a low inventory, that if there is a problem, they know it without needing a system to tell them. "You can't allow a system to run your business".

Not all of Company B's customers use an EDI system. The customers do not want to have the cost associated with EDI, so Company B works with what kind of communication and documentation their customer wants.

The executive interviewed believes that sending documents in PDF form is an improvement over paper documents. The customer can cut and paste the information from the PDF document into their system – whatever kind of system they use. This cuts down on manual keying-in of information.

Company B does not want the customers to be able to see their inventory. They do not even want their own salespeople to be able to see the inventory. This is in case they need to pull the inventory and give it to someone else. They will share inventory with a customer only if it is a product that is unique to that customer – this is usually shared by emailing an Excel spreadsheet.

The executive interviewed believes that forecasting is an "expectation of what you hope will happen in the future". This is another case where computers may cause problems if you "let them run the business". He says that it is important to know the

customer. It is important to keep the inventory at a good level – not too high and not too low. He believes that computer systems will over forecast. Many times customers send him forecasts, but they change so often, that he will not usually look at the forecast for more than two weeks in the future.

Company B's goal is to use the system intelligently without letting the system run the business. Computer systems turn data into information – they don't believe that it is wise to let a computer system make decisions for you – it doesn't take into account all of the variables. They believe that it is important to not take out the human element when doing business. Table 15 shows a summary of Company B's interview results.

Table 15: Company B Interview Results

	Interview Results
Biggest E-business Benefits	• There is increased customer satisfaction due to time savings. • Email has done a lot for improving communication with the customer. The information is cleaner, more efficient, and decisions can be made faster. Follow- up with the customer is more efficient. • With email and their EDI system, they have doubled their output with a small increase in staff (from 7 to 9 employees in the customer service division.) • Electronic order input, summary reports – more efficient process with e-business. Can do 2 times the work.
Biggest E-business Barriers	• Lacking the resources to invest in e-business – lots of small customers. • There is not a good way to measure the effects of e-business.
Website	• The website includes company information so that customers, suppliers, and potential employees can get to know the company. • Maps to the plants are included. • The site is in both English and Spanish. • Sales contacts, along with phone numbers, etc. are also included. • There is a product inquiry form, credit application, and a photo tour of the plants.
Future of e-business	• Although their ERP system is older, they have no plans to upgrade or to link the system to their website.
Internal systems	• All information on the cotton populates their EDI system, but the polyester data does not come in through EDI. • It manages contracts, orders, inventory and plan for production. It does not interface in real time with the plant floor. • It keeps track of the inventory and bar label information, but does not integrate with the machines on the plant floor.
Documents exchanged electronically	• Advance Shipment Notice • Orders from other companies they own automatically populate their EDI system.

Case 3: Company C

Company C is a producer of ring spun, open-end, and air jet yarn. They have plants in the US, Central America, and South America.

Company C has just implemented a new ERP system. They wanted something flexible in an ERP system and something that specializes in textiles. The system that they chose was engineered to fit the business and not the other way around. They wanted to make the system as close as possible to what they are use to on the plant floor in order to avoid accuracy problems. With the new system, they restructured the way they classify yarn. The old system could only handle yarn, but the new system can handle other products as well and also provides more detail on the yarn and access to technical specs online. The system also ties into a costing function which pulls costing from the raw material cost.

They have a reporting tool which allows them to look at such things as individual customers and their shipments to see trends, what a salesman sold by warehouse, and core yarn shipments – this year verses last year. They use this in every planning meeting to look at trends. They use these reports to forecast what the customers are going to want so that they can produce in the off time what they may want in the busier times.

Orders are currently not received via EDI. About 60% come in via email, 30% via fax, and 10% via telephone. All orders to suppliers go through EDI. All cotton info goes straight from suppliers through the intranet to plant to generate bale selection for laydown. The data transferred from cotton system can be used to see what lay down was consumed on a particular date if there is a problem.

The system allows customers to look at shipment information online. It filters their information so that specific customers can look at their inventory (what's on the floor) – products that are specific to them. It also has the ability to allow them to order, but that service is not currently enabled.

Company C experimented with using Yarns.com and did about $1 million in business but then took it down because existing customers would use it. The purpose of using the third-party website was to sell to new customers and they did not want their existing customers purchasing in this way.

They have a webpage with company information and a credit application, but there is not a lot activity with credit on the website. They do not generate a lot of new business from website. Inquiries are usually from competitors from the Far East trying to find out what their prices are.

The executives also note that there is not a whole lot of information exchanging along the supply chain. Their customers do not ask for vendor managed inventory. Customers will send a forecast, but don't really stick to it. Accuracy of yarn forecasting is just a guess. The US textile industry is replenishment from Asia and must be able to "turn on a dime". Table 16 summarized the results of the interviews for Company C.

Table 16: Company C Interview Results

	Interview Results
Biggest E-business Benefits	• EDI makes Company C an advantage to the customer because it may save the customer money. • Benefits – data entry, accuracy of information (fiber data), Advance Shipment Notices. • Eliminates problems with documents not getting to the border on time.
Biggest E-business Barriers	• Allows more visibility to see what they have and to see trends but doesn't really reduce inventory. • Can not see a cost benefit.
Website	• Product information • Six sigma • CBI benefits • Andean Trade Preference Act • Industry information • Product inquiry form • Credit application form • Contact information • Contact feedback form • Company C in the news • Career contact information and benefits
Future of e-business	• They plan to integrate their EDI system with their website. • They plan to allow customers the ability to order online.
Internal systems	• EDI
E-business drivers	• Customer driven • Company C wanted data on fibers
Documents shared electronically with business partners	• A lab report is sent with every shipment – usually via email (PDF). • Type of information shared – Advanced Shipment notification, invoice, 850's, receive ASN for cotton and synthetics, receive invoicing data for cotton, ACH payroll.

Case 4: Company D

Company D was one of the early adopters of new machinery such as OE & Murato machines in the manufacturing of apparel. The markets they are currently in are the bottom weights that serve the vertical companies such as Mt. Vernon & Gayley Lord. They target the industrial market, military market, napery market, and flame retardant mattress market. The keys to their company are speed, quality, and flexibility. They will try to manufacturer anything at least once, so they will never turn down an order.

One of Company D's customers allows them to view 13 weeks of dye lot production for yarn, but only 4 weeks are accurate. They can only see this information for their product, and the system is not integrated with Company D's system. They can only access this information via the internet. The supplier provides this information so that Company D can notify them if there is a lack of raw material to supply their production plan.

Company D has a VPN setup so remote users can access the company's network. They also have an ERP system. They set this system up for internal production information. Then most of the information exchanged with their customers and suppliers is EDI through the use of a VAN. They exchange advance ship notices to the customers and also receive this information from their suppliers. They also receive their HVI data from their suppliers by the use of the software provided by Cotton Inc.

They also use an automatic credit check system via the Internet that is setup for customer orders. They were one of the first textile manufacturers to go to their customers and promote the use of EDI. Being a first adopter allowed them to have a competitive advantage over the market due to their e-business capabilities.

They review bill & hold, inventory, and shipments weekly to manage inventory for their customers. Their goal is to keep the smallest amount of inventory for products and have the most efficient manufacturing schedule. This is done though the visibility of information in the ERP & production planning system. Prior to their adoption of e-business, they had to print inventory sheets daily and the information was only accurate at the beginning of the week. Table 17 shows a summary of the interview results.

Table 17: Company D Interview Results

	Interview Results
Biggest E-business Benefits	• It has eliminated data entry overhead- 2 entries, faxes, and time; increased the accuracy of the information, can see orders in real time so it is available to key decision makers so they have more information to make decisions. Able to track inventory, reduce HVI testing cost, Reduce time & service cost in the credit process
Biggest E-business Barriers	• User resistance from using information on the computer and not using old reports • Customers do not have an IT infrastructure to handle EDI capabilities, and Reluctance towards change of their system
Website	• Company information • Product information and markets served • Contact information • Employment opportunities
Internal systems	• Company D has a VPN setup so remote users can access the company's network. They also have an ERP system. They set this system up for internal production information. Then most of the information exchanged with their customers and suppliers is EDI through the use of a VAN.
E-business drivers	• They were one of the first textile manufacturers to go to their customers and promote the use of EDI. Being a first mover allowed them to have a competitive advantage over the market due to their e-business capabilities
Documents shared electronically with business partners	• They exchange advance ship notices to the customers and also receive this information from their suppliers. They also receive their HVI data from their suppliers by the use of the software provided by Cotton Inc.

Case 5: Company E

Company E spins open end yarn that is used in the manufacture of knit apparel, medical fabric, industrial fabric, automotive, towels, and upholstery. They export a small amount to Canada and Central America, but most of their customers are in the US. The plant is organized into 4 business units that each makes a different product. Each business unit has opening through packaging. They pride themselves on being a customer oriented company that is driven by customer service. They rely on the ability to be flexible to customer demand, making whatever their customer wants.

They have lots of small customers, many of which do not even have email. Company E is more progressive than their customers. They are willing to use e-business if their customer wants it, but their customers currently do not require it. One company executive said that they once sent a survey to their customers to see how they could best serve them – e-business was the least important service to them.

From a marketing perspective, they believe that the big customers already know who spins yarn. E-business may be beneficial in finding customers who don't buy often from spinners. They get most of their new customers from other businesses that are going out of business.

All quality information on cotton bales comes in electronically. They use Cotton Inc.'s EFS system to collect cotton information electronically. The software takes what is in the inventory and creates a mix of bales for the lay down so that the cotton quality is consistent in spinning the yarn. This is very important in order to maintain consistent quality. Also, with this system they can look at what bales are in the inventory and see the quality data of the cotton by bale. They can also see where the bales came from and

the date received, and which bales are in a particular lay down. The USDA puts the information on the Internet and Cotton Inc. downloads it and makes it more user-friendly.

They use email internally. They also use software that collects information from the spinning machines so they can tell where and why there are efficiency losses per machine. They also have new software that allocates production to inventory.

Company E has a website, but they have not seen any benefits. They generate very few leads from the website and the email that is listed is flooded with junk mail. They have a webmaster that helps to get the site a high listing on Internet search engines. The reason for having a website is to provide information about the company to new customers. Table 18 shows a summary of the results from the interview with executives at company E.

Table 18: Company E Interview Results

	Interview Results
Biggest E-business Benefits	• Tracking internal business processes.
Biggest E-business Barriers	• Don't want too many people to have access to the inventory. • The salesmen are not computer literate. • They are nervous about sending out the right information – security issues.
Website	• They have a website, but do not really see any benefits. • Includes product information, company information, contact information, news, and links to textile associations' websites.
Future of e-business	• The #1 thing they want to do next is to provide information automatically to the salesmen. • They would want yarn quality data to be sent to the customer automatically – currently it has to be sent manually
Internal systems	• Inventory tracking. • Plant floor error tracking
E-business drivers	• Customer driven, but currently the customer is not interested
Documents shared electronically with business partners	• Certificate of Analysis Report – sent mostly via email in PDF – fax to some customers through the computer. They do email some PDF files – they have software that includes order entry, forecasting planning, Bill of Laden – go out through email

Case 6: Company F

Company F is a vertical manufacturer of upholstery fabric. They purchase their warp yarn, but produce the specialty yarn to use in the filling of the fabric they produce. All of their customers are in the U.S. and Canada.

They have a website that has contact information, pictures of the plant and a brief explanation of what they do. They have gained no new customers from the website. The website generates about one new lead every quarter that they then send to the salesmen to follow up with. They are not interested in the "casual" customer. They also do not believe that fabric can be sold via the Internet. Customers need to see and feel fabric swatches.

There is no customer pressure to use e-business. Only 5-10% of customers email their orders, but most orders are faxed in. They have 5 or 6 customers who require barcodes on fabric, but all want different information.

They have a customized system on AS400 created by an independent contractor. The AS400 system produces product specification sheets that they then print out and hang on loom so that the weaver knows what to make next. The system does all billings and payroll and inventory control. When an order is entered, a bale sheet is produced. After the fabric is inspected, the bale sheet is applied to the cloth and the barcode is scanned. Then the AS 400 shows it is ready to send to the customer.

They have turned EDI into a "glorified fax machine" because they do not trust it. With EDI, there are some error codes that don't show up, so they EDI the order and then have to fax it also. It is just extra work without benefit.

They receive some forecasting from one customer, but it is not helpful. The furniture business is not that predictable and any glitch in the economy hurts the industry.

If their customers were interested in e-business, then they will do it or if it produced sales. They only have one location and can go out at any point and see what is happening in the plant. He can see that there would be benefits for bigger companies with plants in other locations, but he feels that they are too small to drive innovation of e-business. Table 19 shows a summary of the interview results for Company F.

Table 19: Company F Interview Results

	Interview Results
Biggest E-business Benefits	• Sees little to no benefits for small companies.
Biggest E-business Barriers	• The company is small. • Lack of money. They are struggling to stay in business.
Website	• Contains contact information, pictures of the plant and a brief explanation of what they do. • They do not see any benefits from the website.
Future of e-business	• They do not have any future plans for expanding their e-business solution.
Internal systems	• Billings and payroll and inventory control. • Product specifications.
E-business drivers	• Customer driven, but customers are not interested.
Documents shared electronically with business partners	• Orders are send via EDI, but then also via fax because they do not trust the EDI system.

Case 7: Company G

Company G is a leader in the production of circular knit and warp knit fabrics. They produce high-quality fabrics for specialized applications such as wrinkle-free, no run hospital linens, thermal blankets, antimicrobial clothing and linens, and institutional thermal fleece for prisons. They will try and produce whatever the customer wants and will do any size order. They have a small marketing budget and hope that by giving their

customer a superior quality product, they will tell others and grow their business. Their goal is to have the best product in the market in terms of cost, quality, functionality and service.

They do have a website that serves as a tool to educate people on their business. It includes company and product descriptions, news, and contact information. They spent $15,000 on website, 1/3 of which was for search engine optimization. The website generates calls from all over the world. They use the website not only for marketing, but also in new product development, encouraging visitors to their website to contact them with ideas for new ways to use their products.

They have a computer system with individual modules that are not integrated at this time. They make decisions based on historical data reports generated through the system. They have the ability to look at inventory from different locations.

Orders are generally faxed in. They come all come in different forms from different companies. The order is then written and put into the system database which puts the order in their format. They then mail an order confirmation and thank-you note to customer.

They communicate via email with customers and suppliers. They email product specs. A lot of their customers are not computer savvy, however. They use the Internet to search for suppliers and investigate potential customers. They do not use EDI, but would if their customers required it. They do use the North Carolina state government's e-procurement website because it is required to do business with them, but they would rather not. It makes more work for them and adds 1.75% up charge for using the system, which they then have to reflect that in their prices.

They do not buy yarn without picking up the phone and talking to someone. Customer forecasting is not accurate. They rely on their suppliers to act quickly and respond on time. Table 20 shows a summary of the interview results for Company G.

Table 20: Company G Interview results

	Interview Results
Biggest E-business Benefits	• Communication, marketing, generating ideas.
Biggest E-business Barriers	• Small marketing budget.
Website	• They do have a website that serves as a tool to educate people on their business. It includes company and product descriptions, news, and contact information. They spent $15,000 on website, 1/3 of which was for search engine optimization. The website generates calls from all over the world. They use the website not only for marketing, but also in new product development, encouraging visitors to their website to contact them with ideas for new ways to use their products.
Future of e-business	• N/A
Internal systems	• Individual modules that are not integrated at this time. • Historical data reports generated through the system. • Ability to look at inventory from different locations.
Documents shared electronically with business partners	• Product specifications are sent via email

Case 8: Company H

Company H focuses specifically on narrow elastics for intimate apparel industry and has become one of the most respected and well known manufacturers of narrow elastics in the country. They manufacture a broad range of narrow fabric products, including both elastic and non-elastic fabrics, which are created on a variety of highly specialized machinery. The Company is one of the leading manufacturers of narrow elastic fabrics, and the vast majority of the Company's elastic product line is sold to well-known manufacturers of women's lingerie. In addition to elastic fabrics, they also extrude

silicone onto fabrics that are used in the hosiery and intimate apparel market. Another area of significance is the manufacture of cast fabric for the medical industry.

The executive interviewed said that profits in the textile industry are so low that it is difficult justify e-business. The biggest hurdle to e-business is the cost. They would rather spend money on equipment that will produce something and generate profits. There are too many suppliers in the market, making it difficult to make profits. Currently, Company H has 11 competitors in the US. He predicts that it will go down by a third or a half. They currently have competitors that want to sell their business to Company H. They feel that they are the most modern company in this segment and are leaders worldwide in technology and design innovation.

They have become more vertical because their suppliers will drop a certain type of yarn if they are not making a certain margin. Therefore, they now have their own yarn twisting and manufacture their own equipment. Forecasting does not help at all and if they are late for any reason, the retail companies will cancel the order or make them pay late fees. They want to get into the medical textiles market.

Internally, the main system produces invoices and payments to shipping manifests. A majority of orders come in via email and they respond electronically to customers. All planning is done manually. Everything in mill is tracked through the system. Barcodes are scanned from one process to the next so that a product can be tracked all the way through the manufacturing process. Currently the system is only available locally and can not be viewed at their overseas offices. Eventually, they plan to move to one system company-wide.

They have a website with company information, product descriptions, and contact information. They get some inquiries, but the website has generated no new customers.

Internally, 90% of the communication is through email. He believes that email has fueled global growth. It is especially helpful when dealing with their European office, which is six hours ahead.

Currently, he believes that there are too many other problems to worry about and that when the global market settles down, e-business will be the next big thing for them to focus on. Reducing cost is the number one objective. If e-business could eliminate labor, then it would be worthwhile. Electronic payments are one way that e-business helps to save money. Table 21 provides a summary of the interview results with Company H.

Table 21: Company H Interview Results

	Interview Results
Biggest E-business Benefits	• Communication overseas.
Biggest E-business Barriers	• Cost
Website	• Company information, product descriptions and contact information. • Has not generated new customers.
Future of e-business	• Plan to integrate their system company-wide.
Internal systems	• Invoices and payments through shipping manifests. • Tracks inventory through the production process.
E-business drivers	• Cost reduction.
Documents shared electronically with business partners	• Orders are received via email.

Case 9: Company I

Company I is a specialty denim manufacturer. Of the US locations owned by the parent company, the one in North Carolina produces denim fabric. The NC plant

produces 325,000 yards of denim fabric a week and is small and flexible with a niche customer base – specialty denim for boutiques and other high priced denim makers. The executive interviewed spoke in regard to the North Carolina plant.

Company I sells a few fabrics in Europe and sells to about two dozen significant contractors in Latin America, but most of their customers are small "mom and pop" companies in the US. They have approximately 2000 customers with a total of about 100 active at any one time and about 12 ongoing, long-term customers. They sell denim to both contractor apparel companies and directly to apparel designers.

The executive interviewed defines e-business as "business transacted between suppliers and customers using means other than the postal service, including fax".

They send documents to their customers and suppliers via email in the form of excel and PDF files. They use electronic payments to pay most suppliers; otherwise they will only write a check once a month manually for those who will not accept an electronic payment payment. They have problems with some suppliers who do not want to give out their bank account information because they are worried about security issues. They do some supplier ordering online for office supplies, but not for direct production goods. They do little or no electronic exchange for yarn.

Internally, their computer system, they can monitor the progress of production on the plant floor. Data is collected on the product at each point in the manufacturing process via barcodes that are scanned. It is important for them to know where everything is in production at all times because they keep such low inventory and most of their products are "made-to-order". The manufacturing equipment is state of the art and if

there is an error, it will dial into the equipment manufacturer's customer service to fix the problem.

They want to be the most creative and forward thinking in terms of the design and manufacturing of denim. It is not the company's strategy to be ahead in e-business. They want to see what works for others and take the pieces they need and maximize their existing investment. They are more interested in spending money where they can see a return on their investment.

They have a web presence that is controlled by the European office. It provides contact information and general company information. They have not seen any difference in their market share due to the website. He says that it is not a diverse market in terms of the number of players. Specialty denim is a very tight circle and everyone in the business already knows who is manufacturing it. There are very few denim manufacturers, so the customers know who they are and what their specialties are. They use the Web to research potential customers – to investigate their ethics, finances, etc.

They do not sell online. In Europe, they use a "secure zone" that allows agents and some customers to access order status, but it hasn't been an issue in the US market, so they haven't expanded it to US customers. Exchange of information is done mostly via email.

He sees the greatest benefit from e-business, and specifically email, as the "expediency with which we can do business (complete a task)". The downside to this, however, is that their customers and suppliers and they have come to expect and live by this and have become impatient.

One of their customers wanted them to get EDI, but they do not do enough business with them to make it worthwhile. So the use a third party who takes an Access database that is emailed as an attachment, translates it to EDI format, and transfers it to the customer.

Levis also wanted them to get an EDI solution but they declined – the low price denim business is not a business that they want to grow.

He feels that EDI is obsolete, very costly to maintain, not easily usable or interchangeable. He believes EDI is a legacy technology and textile companies have not moved to Internet technology because they already have a significant investment in EDI and are accustomed to it. He also points out that the sophistication of workforce is a major problem. He believes that the three biggest barriers to becoming e-business enables are systems integration, training and acceptance by workforce. He also worries about losing the personal relationship with the customer.

They use a VPN with very strict security to communicate with their parent company. They have been developing an intranet for about 4 years, but it has not been a high priority. The IT manager is doing it in his spare time. They see a benefit in having an intranet so that the same document is not stored on different desktops. They do not currently see a need for an extranet, however. A planning/scheduling tool is the next e-business investment that they are looking into, but he feels that there is currently an inconsistency of performance of existing tools in this area. Table 22 provides a summary of the interview with Company G.

Table 22: Company I Interview Results

	Interview Results
Biggest E-business Benefits	• "expediency with which we can do business"
Biggest E-business Barriers	• Systems integration • Training • Acceptance by workforce • Small customers that are not computer savvy. • Afraid of losing the personal relationship with the customer.
Website	• Controlled by parent company. • Company and contact information. • Has not increased their market share.
Future of e-business	• Planning/scheduling tool. • Intranet.
Internal systems	• Track the progress of production on the plant floor. • VPN with parent company.
E-business drivers	• Customer driven.
Documents shared electronically with business partners	• Electronic payments to suppliers.

Phase II-B Case Study Results

The results of the case studies were analyzed in relation to each of the research objectives.

RO1. Identify e-business initiatives currently used by textile manufacturers.

Finding 1: E-business is not prevalent in the textile manufacturing industry in North Carolina. Although, most companies at least have a website, a majority of them use it for a marketing tool only, and not to perform business transactions with their trading partners. This is similar to the results of the e-business Watch survey (2005) that states:

> "While the large majority of companies have a website, only a minority of them use it with a proactive marketing purpose. The web can be used not only for

selling goods or showing catalogues, but also for establishing a customer community, sharing values, picking up trends and, to a certain extent, influencing customers' choices" (p. 48).

Finding 2: Email is most commonly used by companies to communicate with their business partners electronically. Some companies email PDF files or Excel files to customers and suppliers. The documents emailed include orders, invoices, and advance shipment notices.

Finding 3: Many companies interviewed have systems for tracking internal business processes, but are not linked up with their customers' and suppliers' systems. Only one of the companies interviewed allows their business partners to log into their system and view their inventory. This is a conscious decision, as they want to be able to distribute the inventory as they see fit. For example, they may want to reallocate inventory originally intended for one customer to another who needs it sooner. They would not want to share this information with their customers. Some companies may email files to their customers with inventory information that is specific to that customer.

RO2. Identify e-business initiatives being considered by textile manufacturers.

The companies interviewed, for the most part, are interested only in expanding into e-business if it is required of them by their customers. One company is interested in acquiring a planning and scheduling system. For most of the companies interviewed, email was about as complex as most of their customers were capable of.

RO3. Identify benefits to the adoption of e-business initiatives.

Time savings and communication seem to be the most often mentioned benefits of e-business to the executives interviewed. They also mentioned error reduction as a benefit.

RO4. Identify barriers to the adoption of e-business initiatives.

Finding 1: Similar to the study conducted by the e-business watch (2005), small company size is a major reason why many of the companies interviewed indicated that they are not using e-business or are not using it to its full potential. The e-business watch report (2005) stated that, "The adoption of e-business in this industry is mainly demand driven. Pressure from distribution and business partners along the value chain are the main motivations" (p. 7). Many of the industry executives interviewed agreed with this statement, indicating that they would invest more in e-business if their customers requested it.

Finding 2: The e-business watch report (2005) also states that, "many firms not only lack the financial capacity to make investments, but also the skills of how to introduce and manage organizational change. Moreover, the limited degree of computerization and the diversity of technological equipment in place are constraints for the adoption of e-business" (p. 8). This also seems to be the consensus in the North Carolina textile industry. Several of the executives interviewed indicated that the lack of skilled staff was an issue for them as well as for their customers.

Finding 3: The executives interviewed also indicated that they could not justify the investment in e-business. They would rather invest in technology and equipment that will produce or improve their product and generate revenue.

RO5. Determine which e-business initiatives textile manufacturers deem to be most important for achieving a more competitive strategy.

Most companies interviewed do not see e-business as the way to achieve a more competitive strategy, although many did mention that tightening up the supply chain, in general, is something that desperately needs to be accomplished. All of the companies interviewed produce goods to order and strive to keep inventory as low as possible. Excellent communication along the supply chain is critical to get the product to the customer on time.

One company was investigating using e-business to allow their sales team to view the inventory and enter orders remotely. Another company was investigating purchasing a planning and scheduling software package to increase efficiency internally.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this research was to improve the decision making process of textile manufacturers by providing them with information on how the North Carolina textile manufacturing industry is using e-business. This study reveals what e-business initiatives they are planning to invest in next, the benefits they are gaining, the challenges they are facing, and in what areas they expect to see the greatest future benefits from e-business. It is important to note that the focus of this study is on business-to-business e-business in textile product mills. This study does not include textile product mills or apparel manufacturers, which are included in other studies of e-business in textiles.

The methodology used in this study consisted of two phases. Phase I was an analysis of secondary sources. A database of textile manufacturing companies in North Carolina with a primary NAICS code of 313 was compiled using information from Reference USA and Harris Selectory Online. The resultant database consisted of 590 companies that were to be called to verify the information and request participation in Phase II-A, the questionnaire. The questionnaire was developed using information collected from the literature review and the analysis of similar studies performed abroad.

Phase II of the study consisted of two parts. Phase II-A was the distribution and analysis of the questionnaire. The questionnaire was mailed to 328 companies and 117 usable responses were received. After adjusting for undeliverable, unusable, and blank surveys, the resulting response rate was 38.1%. Phase II-B utilized case study

methodology and built on the results of the questionnaire to gain a more in-depth understanding of the subject. The sample consisted of 7 companies in North Carolina and 2 companies in South Carolina. South Carolina was not intended to be part of the sample, originally, but the opportunity to visit these companies arose and the information received was beneficial in adding to the results obtained from the survey.

Conclusions

1. Identify e-business initiatives currently used by textile manufacturers.

Email and inventory management were reported as the electronic facilitators most often used for internal business processes by the companies interviewed for the case study portion of the research. Most of the companies interviewed (8 out of 9) and a majority of those that answered the survey have a website (67%). However, few are using the tool to its full potential, with most companies providing just basic company and product information on their website. The company executives interviewed seemed to think, for the most part, that the website was not benefiting the company at all and almost seemed to view it as more of a necessary evil, generating a lot of junk email and fake inquiries and no real customers.

The business activity that was most often facilitated through electronic means was exchanging documents *electronically with suppliers*, which was reported by 58.1% of those that answered that question on the survey. This was also indicated as a main area in the case study interviews. Although, the question on the survey indicated using means other than email, the case study responses seem to indicate that email may be the main way that companies are exchanging documents both with their customers and suppliers. Many of the executives interviewed indicated using email to send PDF and Excel files to

their business partners, as well as for general communication and occasionally receiving orders via email. EDI may also be another method, although it is not clear from the survey, it was mentioned in the case studies interviews.

2. Identify e-business initiatives being considered by textile manufacturers.

Most of the executives interviewed did not have specific plans for expanding their e-business initiatives. One company had just installed a new ERP system and is planning to link it to their website sometime in the future and another had just gone live with their website in 2006. In another interview, it was mentioned that they were investigating investing in a planning and scheduling tool. The survey responses indicated that 24.5% of companies are planning to add *sales support* to their website, followed by 22.3% with plans to add *logistics services* and 22% with plans to add *customer support*. 18.3% of companies have plans to use electronic means to *sell goods internationally*, followed by 14.3% to *manage capacity or inventories*, and 12.6% to *purchase direct production goods*.

3. Identify benefits to the adoption of e-business initiatives.

The benefits of e-business seem to be difficult for companies to see because they are difficult to quantify. Companies are looking for ways to increase their revenue and are just not seeing the cost-benefits of e-business. They do recognize, however, that e-business has benefits in terms of communication, information exchange, and time savings. 46.2% of the respondents indicated experiencing a benefit of *improved communication with customers or suppliers* and 45.3% experienced having *better access to information*. Case study interviews indicated that there was also some increase in

efficiency and emphasized the value associated with using email especially to communicate with business partners in different time zones.

4. Identify barriers to the adoption of e-business initiatives.

The main barriers of e-business in the North Carolina textile industry stem from the following industry-specific issues:

- the abundance of micro, small, and medium sized companies that make up the textile industry,
- the "conservative" culture of the textile industry, and
- the increasing competition from foreign competitors.

This is similar to the findings of the European Commission's sector report on e-business in the textile and clothing industry. According to the e-Business Watch report (2005):

> "The main barriers to the adoption of e-business in this industry are mainly related to the negative market trends and the increasing competition which affect overall investment capacity at a general sector level. SMEs in this industry may have difficulty with the introduction of new technologies not only for financial reasons but also due to the shortage of technical skills to manage new ways of operating" (p. 57).

Table 24 lists the major barriers that survey respondents reported experiencing with their e-business initiatives. Security issues are still a major concern even though there are measures that can be taken to overcome or at least minimize this risk. This is an indication of the conservative attitude of the textile industry. In one interview with a textile executive, he emphasized the secrecy under which many textiles operate. They are afraid to share information even with their own business partners. The lack of skilled

staff is another issue related to the many small firms in the industry. Although e-business may be a way for North Carolina textile companies to compete with foreign competitors, this competition is also one of the limiting factors. Due to the pressures from global competitors, N.C. textile firms have limited capital. As indicated in the case studies, this makes it difficult to justify the cost of an e-business solution when they cannot see an immediate return on investment like they can with a new piece of equipment that will increase their production efficiency. Change in general is something that is generally difficult for textile companies due to the conservative culture. One textile executive interviewed said that many weavers and knitters will not even try to produce new products that will give them a competitive advantage. He has seen instances where, weavers especially, will turn down business that they have the ability to produce because it is in a different market than they produce for. With this type of resistance to change, convincing them of the benefits of e-business is difficult.

5. **Determine which e-business initiatives textile manufacturers deem to be most important for achieving a more competitive strategy.**

Information exchange is the area in which NC textile industry executives expect to see the greatest benefits in the near future. For the most part, respondents do not see e-business as "the way" to make them more competitive. They are more interested in spending money on new equipment and being innovative in product development.

6. **Develop a conceptual model of e-business for textile manufacturing.**

Figure 33 shows the conceptual model created based on the survey responses and case studies. The right side illustrates the current state of electronic exchange among sectors of the supply chain is limited and fragmented. The left side of the model

illustrates the potential use of e-business to integrate and collaborate with supply chain partners starting with the fiber producer all the way to the end consumer. The current level of electronic exchange of information along the supply chain consists of communicating one level up or one level down – usually via email or sometimes using EDI. The potential level of electronic exchange consists of exchanging information from the beginning of the supply chain all the way to the end consumer, sharing information at each level. This can be accomplished through the use of Internet technologies.

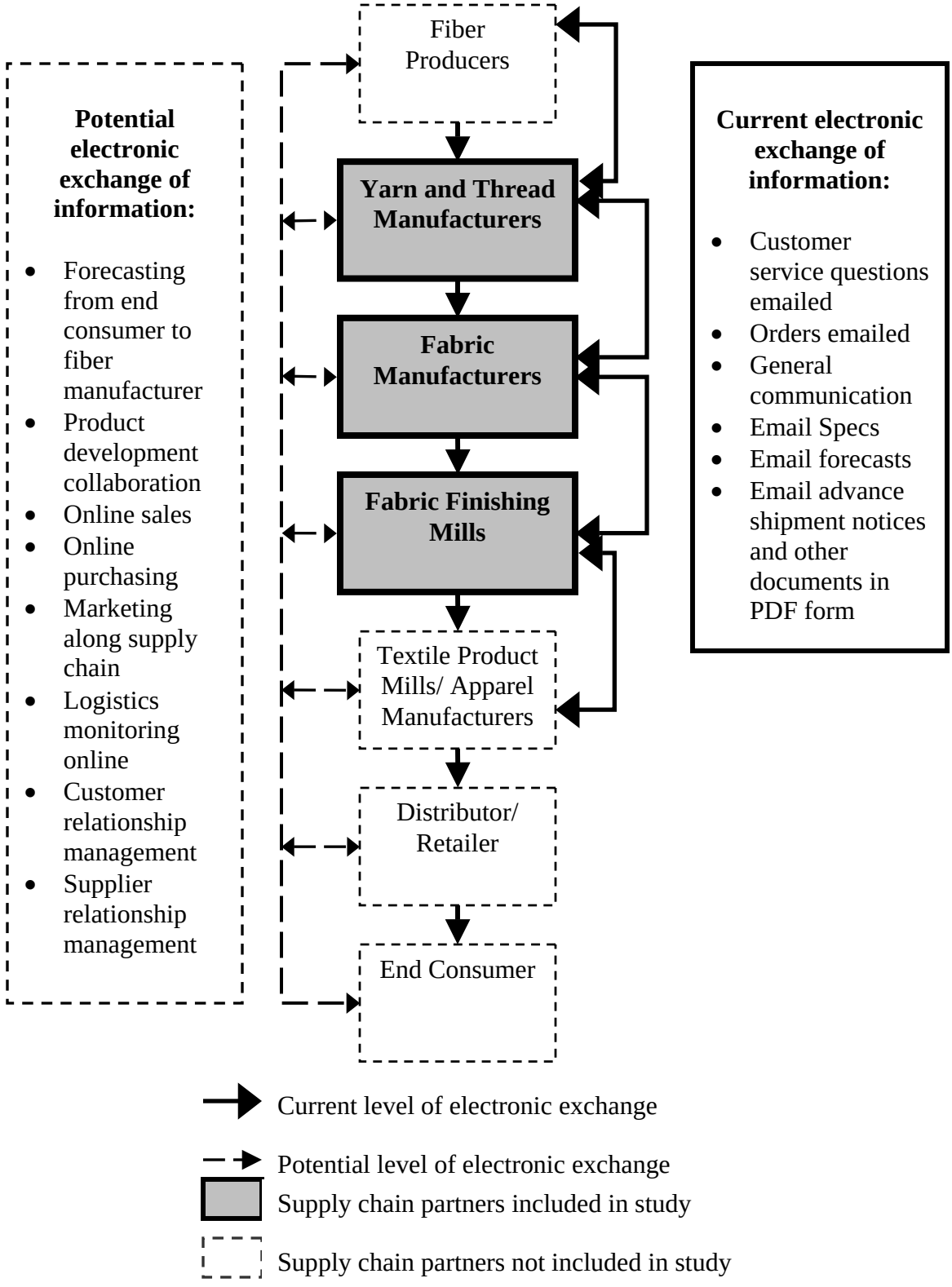

Figure 35: Conceptual model of the current and potential use of e-business in the textile supply chain

Recommendations for Future Research

1. Because this study focuses on North Carolina textile manufacturers only, the research could be expanded to include the entire United States.
2. Future research should include nonwovens companies who were not included in this study due to the lack of response.
3. Future research could include fiber producers and textile product mills to see if there is a difference in the results by moving further up or further down the supply chain.
4. More in-depth analysis could be done to determine a way for textile manufacturers to calculate an ROI for different e-business solutions.
5. More research into specific e-business solutions that meet the special needs of the textile industry can be done.
6. Research can be done on developing tools to aid textile executives in deciding on an e-business solution.
7. Case studies with companies that are experiencing gains from their e-business solution can be performed in order to provide benchmarks for other textile manufacturers.
8. Further studies could modify the survey so that more in-depth analysis can be done on specific areas of e-business that are important to textile manufacturers.
9. Research on the sharing of information along the supply chain would be beneficial.

CHAPTER VI

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APPENDIX A : FIELD TEST COVER LETTER

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Technology and Management
Campus Box 8301, NCSU
Raleigh, NC 27695-8301
(919) 515-6449 (office)
(919) 515-3733 (fax)

Dear :

I would like to request your participation in a research study about the use of e-business as part of a competitive strategy in the US textile manufacturing industry. This study is part of an effort to learn how textile manufacturing companies are using the Internet to stay competitive in the global market. The results of this study will benefit the US textile industry by providing information on how textile companies are using e-business with their trading partners and to create a model that will aid companies in deciding which e-business strategies are best suited to their company's needs.

Your help in determining the best instrument to gain this information is requested. A pilot survey is included in your packet. Please fill out the survey and the survey evaluation form. Any additional comments can also be made on the survey itself next to the appropriate question.

I emphasize that all information is **confidential**. All data will be reported in aggregate form to ensure that no individual companies will be identified. We will also present the results of this pilot study.

Your cooperation is greatly appreciated. Thank you very much for your help in this study.

Sincerely,

Christy Cagle
Doctoral Candidate

George Hodge
Professor and Project Chair

APPENDIX B : FIELD TEST QUESTIONNAIRE

Start time: _____

The purpose of this survey is to determine the level of implementation of your company's e-business solution and to assess the benefits and barriers that your company has faced in regard to e-business as well as future expectations for e-business in your company. While filling out the survey, please respond to each question with regard to the particular division of the company that you work for. The questions refer to business-to-business and not business-to-consumer transactions.

1. Is your company a US-owned company?

Yes	No
1	2

2. Please circle your primary business activity (circle one):

1 Yarn Texturing, Throwing, and Twisting (NAICS 313112)
2 Broadwoven Fabric (NAICS 313210)
3 Schiffli Machine Embroidery (NAICS 313222)
4 Weft Knit Fabric (NAICS 313241)
5 Broadwoven Fabric Finishing (NAICS 313311)
6 Fabric Coating (NAICS 313320)
7 Yarn Spinning (NAICS 313111)
8 Thread (NAICS 313113)
9 Narrow Fabric (NAICS 313221)
10 Nonwoven Fabric (NAICS 313230)
11 Other Knit Fabric and Lace (NAICS 313249)
12 Textile and Fabric Finishing (Except Broadwoven Fabric) (NAICS 313312)
13 Other. Please Specify _____

3. How many full-time employees does your company have?

1 1-4 workers
2 5-9 workers
3 10-19 workers
4 20-49 workers
5 50-99 workers
6 100-249 workers
7 250-499 workers
8 500-999 workers
9 1000 or more workers

4. Your job title:

1 President/ CEO
2 Chief Information Officer
3 Marketing VP/ Director/ Manager
3 Sales VP/ Director/ Manager
4 Information Technology Manager
5 Manufacturing Manager
6 Other _____

5. Does your company manufacture goods in:

1 The US

2 Abroad

3 Both

4 No manufacturing facilities

5 Don't know

6. Does your company have a website?

Yes	No
1	2

7. Which of the following services does your company's website offer or plan to offer to your customer?

1	**2**	**3**	**4**	**5**	**N/A**
Currently Use	*Plan to Use in the next 6 months*	*Plan to Use in the next 5 years*	*No plan to use*	*Unsuccessfully used in the past*	*Not Applicable*

Background information on the company (contact info, history, mission statement, etc.)	1 --- 2 --- 3 --- 4 --- 5 N/A
Industry news and information	1 --- 2 --- 3 --- 4 --- 5 N/A
Product information	1 --- 2 --- 3 --- 4 --- 5 N/A
Product catalog (with prices and ordering information)	1 --- 2 --- 3 --- 4 --- 5 N/A
Customer support	1 --- 2 --- 3 --- 4 --- 5 N/A
Allows customers to order products and services online	1 --- 2 --- 3 --- 4 --- 5 N/A
Allows customers to make electronic payments	1 --- 2 --- 3 --- 4 --- 5 N/A
Logistics services (inventory, order tracking)	1 --- 2 --- 3 --- 4 --- 5 N/A
Sales support	1 --- 2 --- 3 --- 4 --- 5 N/A
Online auctions	1 --- 2 --- 3 --- 4 --- 5 N/A

8. Does the company use online technologies other than email, like for example the Internet or an extranet, to facilitate the following business activities?

1	**2**	**3**	**4**	**5**	**N/A**
Currently Use	*Plan to Use in the next 6 months*	*Plan to Use in the next 5 years*	*No plan to use*	*Unsuccessfully used in the past*	*Not Applicable*

Collaborate with business partners in the design of new products	1 --- 2 --- 3 --- 4 --- 5 N/A
Collaborate with business partners to forecast product demand	1 --- 2 --- 3 --- 4 --- 5 N/A
Manage capacity or inventories	1 --- 2 --- 3 --- 4 --- 5 N/A
Exchange documents electronically with your suppliers	1 --- 2 --- 3 --- 4 --- 5 N/A
Purchase MRO (manufacturing, repair and operating) goods	1 --- 2 --- 3 --- 4 --- 5 N/A
Purchase direct production goods	1 --- 2 --- 3 --- 4 --- 5 N/A
Sell goods domestically	1 --- 2 --- 3 --- 4 --- 5 N/A
Sell goods internationally	1 --- 2 --- 3 --- 4 --- 5 N/A
Manage Customer Relationships	1 --- 2 --- 3 --- 4 --- 5 N/A
Manage Supplier Relationships	1 --- 2 --- 3 --- 4 --- 5 N/A
Logistics Management	1 --- 2 --- 3 --- 4 --- 5 N/A

9. What effect, if any, has your company's e-business initiative had on the following business areas?

-2	-1	0	1	2	N/A
Very Negative	*Fairly Negative*	*Neither Positive nor Negative*	*Fairly Positive*	*Very Positive*	*Not Applicable*

Volume of the company's sales	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Number of customers	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Number of suppliers	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
The company's sales area	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
The quality of the company's customer service	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
The efficiency of the company's internal business processes	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
The costs of logistics and inventory	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Supplier relationships	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Procurement costs	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Organizational structure	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Offer of products and services	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Quality of products and services	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Time savings	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Communication with customers and suppliers	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Business competitiveness	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Meeting demands of customers	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Meeting demands of suppliers	(-2) --- (-1) --- 0 --- 1 --- 2	N/A
Access to information	(-2) --- (-1) --- 0 --- 1 --- 2	N/A

10. Which of the following does your company view as barriers to implementing an e-business solution? Circle all that apply and then rank the top 5 barriers with 1 being the most important barrier.

		Rank top 5
1	Lack of shared technical standards	_____
2	Security issues	_____
3	Data protection or privacy issues	_____
4	Cataloging and classification issues	_____
5	Business messaging or transaction processing	_____
6	Initial cost is too high	_____
7	Time constraints	_____
8	Lack of skilled staff	_____
9	Readiness of business partners	_____
10	Lack of support from upper management	_____
11	Lack of proven business benefits	_____
12	Lack of direct customer contact	_____
13	Other, please specify_____	_____
14	Other, please specify_____	_____
15	Other, please specify_____	_____
16	Other, please specify_____	_____

11. What benefits has your company found from your e-business activities? Circle all that apply and rank the top 5 benefits with 1 being the most important benefit.

	Rank top 5
1 Reduced costs	_____
2 Increased turnover	_____
3 Increased efficiency	_____
4 Increased profits	_____
5 Improved communication with customers or suppliers	_____
6 Improved communication with staff	_____
7 More competitive organization	_____
8 Better access to information	_____
9 Increased market share	_____
10 Improved quality of products and services	_____
11 Improved delivery time to customers	_____
12 Increased responsiveness to customers	_____
13 Other. Please specify _____	_____
14 Other. Please specify_____	_____
15 Other. Please specify_____	_____
16 Other. Please specify_____	_____

12. In which area(s) do you expect to see the greatest benefits from e-business in the near future (within the next 18 months)?

1 Customer Relationship Management
2 Supplier Relationship Management
3 Product Development
4 Logistics Management
5 Supply Chain Management
6 Information exchange
7 Other. Please Specify_____

Thank you so much for taking the time to complete this survey. If you would be interested in helping us further our research efforts through in – person, email or telephone interviews, or if you would like to receive a summary of the results of this study please provide your contact information below.

☐ I would like to receive summary information

I would like to participate in further research. Please contact me by:

☐ Phone _____

☐ Email _____

Company Name _____

Contact Name _____

Address _____

_____

Time Survey Completed:_____

APPENDIX C : FIELD TEST EVALUATION FORM

FIELD TEST EVALUATION FORM

Please use this form to give your critical reaction to the questionnaire once you have completed it.

1. Did the cover letter make you want to fill out the questionnaire? (If not, what else might have been said?)

2. Was there anything special that made you want to or not want to fill out the questionnaire?

3. What problems, if any, did you have in answering the questions? Please indicate which question(s) (letter and number) and the problem(s) you had.

4. If there were questions for which you did not find an appropriate answer given and no opportunity to list your own, please indicate which question(s) and your answer(s).

5. Did you find the questionnaire easy to fill out?

6. Was the size of the print too small?

7. Do the sections of the questionnaire come in an appropriate order?

8. If you had received this questionnaire in the mail, would you have completed and returned it in a provided self-addressed stamped envelope?

9. About how long did it take you to fill out the questionnaire?

10. Please give any other suggestions or comments that would improve the questionnaire. (Use the back of this page for your additional comments).

THANK YOU VERY MUCH!

RETURN THIS CRITIQUE FORM WITH YOUR COMPLETED QUESTIONNAIRE

APPENDIX D : COVER LETTER

«FirstName» «LastName»
«Company»
«Address1»
«City», «State» «PostalCode» «zip4»

I would like to request your participation in a research study about the use of e-business as part of a competitive strategy in the North Carolina textile manufacturing industry. This study is part of an effort to learn how textile manufacturing companies are using the Internet to stay competitive in the global market.

We are contacting all textile manufacturing companies in the state of North Carolina that have a primary NAICS code of 313 to ask about their experiences with e-business strategies, the benefits that they have seen and the barriers they have faced. Even if no attempts at using e-business as a competitive strategy have been used, we are interested in understanding the reasons for not using this resource.

The results of this study will benefit the US textile industry by providing information on how textile companies are using e-business with their trading partners and to create a model that will aid companies in deciding which e-business strategies are best suited to their company's needs.

I emphasize that all information is **confidential**. All data will be reported in aggregate form to ensure that no individual companies will be identified. When you return your completed questionnaire, your name will be deleted from the mailing list and never connected to your answers in any way. This survey is voluntary. However, your response would help us greatly. If for some reason you prefer not to respond, please let us know by returning the blank questionnaire in the enclosed envelope.

We would be happy to send you a summary of the results of the study upon your request.

If you have any questions or comments about this study, we would be happy to talk with you. Please feel free to contact us via email at cmcagle@unity.ncsu.edu, via phone at 919-515-6579, or you can write us at the address on the letterhead.

Your cooperation is greatly appreciated. Thank you very much for your help in this study.

Sincerely,

Christy Cagle
Doctoral Candidate

George Hodge
Professor and Project Chair

APPENDIX E : QUESTIONNAIRE

Survey of E-Business Practices in the North Carolina Textile Manufacturing Industry

The purpose of this survey is to determine the level of implementation of your company's e-business solution and to assess the benefits and barriers that your company has faced in regard to e-business as well as future expectations for e-business in your company. The questions refer to business-to-business and not business-to-consumer transactions.

---

1 **Does your company have a website?**

☐ No

☐ Yes

2 **Which of the following services does your company's website offer or plan to Offer to your customer?**

Please check one box per line.

	Unsuccessfully Used in the Past	No Plan to Use	Plan to use in the next 5 years	Plan to use in the Next 6 Months	Currently Use	Not Applicable
a. Background information on the company (contact info, history, mission statement, etc.)…	☐	☐	☐	☐	☐	☐
b. Industry news and information…….	☐	☐	☐	☐	☐	☐
c. Product information……..	☐	☐	☐	☐	☐	☐
d. Product catalog (with prices and ordering information)…..……	☐	☐	☐	☐	☐	☐
e. Customer support……..….	☐	☐	☐	☐	☐	☐
f. Allows customers to order products and services online……..……	☐	☐	☐	☐	☐	☐
g. Allows customers to make electronic payments……..	☐	☐	☐	☐	☐	☐
h. Logistics services (inventory, order tracking)……	☐	☐	☐	☐	☐	☐
i. Sales support…….	☐	☐	☐	☐	☐	☐
j. Online auctions…….	☐	☐	☐	☐	☐	☐

3 **Does the company use online technologies other than email, like for example the Internet or an extranet, to facilitate the following business activities?**

Please check one box per line.

	Unsuccessfully Used in the Past	No Plan to Use	Plan to use in the next 5 years	Plan to use in the Next 6 Months	Currently Use	Not Applicable
a. Collaborate with business partners in the design of new products……..……	☐	☐	☐	☐	☐	☐
b. Collaborate with business partners to forecast product demand……..	☐	☐	☐	☐	☐	☐
c. Manage capacity or inventories…….	☐	☐	☐	☐	☐	☐
d. Exchange documents electronically with your suppliers……	☐	☐	☐	☐	☐	☐
e. Purchase MRO (manufacturing, repair and operating) goods……	☐	☐	☐	☐	☐	☐
f. Purchase direct production goods……..	☐	☐	☐	☐	☐	☐
g. Sell goods domestically…….	☐	☐	☐	☐	☐	☐
h. Sell goods internationally…….	☐	☐	☐	☐	☐	☐
i. Manage Customer Relationships……	☐	☐	☐	☐	☐	☐
j. Manage Supplier Relationships…….	☐	☐	☐	☐	☐	☐
k. Logistics Management……	☐	☐	☐	☐	☐	☐

4 **What effect, if any, has your company's e-business initiative had on the following business areas?**

Please check one box per line.

	Very Negative	Fairly Negative	Neither Positive nor Negative	Fairly Positive	Very Positive	Not Applicable
a. Volume of the company's sales	☐	☐	☐	☐	☐	☐
b. Number of customers	☐	☐	☐	☐	☐	☐
c. Number of suppliers	☐	☐	☐	☐	☐	☐
d. The company's sales area	☐	☐	☐	☐	☐	☐
e. Quality of the company's customer service	☐	☐	☐	☐	☐	☐
f. The efficiency of the company's internal business processes	☐	☐	☐	☐	☐	☐
g. The costs of logistics and inventory	☐	☐	☐	☐	☐	☐
h. Supplier relationships	☐	☐	☐	☐	☐	☐
i. Procurement costs	☐	☐	☐	☐	☐	☐
j. Organizational structure	☐	☐	☐	☐	☐	☐
k. Offer of products and services	☐	☐	☐	☐	☐	☐
l. Quality of products and services	☐	☐	☐	☐	☐	☐
m. Time savings	☐	☐	☐	☐	☐	☐
n. Communication with customers and suppliers	☐	☐	☐	☐	☐	☐
o. Business competitiveness	☐	☐	☐	☐	☐	☐
p. Meeting demands of customers	☐	☐	☐	☐	☐	☐
q. Meeting demands of suppliers	☐	☐	☐	☐	☐	☐
r. Access to information	☐	☐	☐	☐	☐	☐

5 **In which area(s) do you expect to see the greatest benefits from e-business in the near future (within the next 18 months)? Mark all that apply.**

- ☐ Customer Relationship Management
- ☐ Supplier Relationship Management
- ☐ Product Development
- ☐ Logistics Management
- ☐ Supply Chain Management
- ☐ Information exchange
- ☐ Other, please specify _____
- ☐ Other, please specify _____
- ☐ Other, please specify _____
- ☐ Other, please specify _____

6 **Which of the following has your company experienced as benefits gained from your e-business activities? Mark all that apply.**

- ☐ Reduced costs
- ☐ Increased turnover
- ☐ Increased efficiency
- ☐ Improved communication with customers or suppliers
- ☐ Increased profits
- ☐ Improved communication with staff
- ☐ More competitive organization
- ☐ Better access to information
- ☐ Increased market share
- ☐ Improved quality of products and services
- ☐ Improved delivery time to customers
- ☐ Increased responsiveness to customers
- ☐ Other, please specify _____
- ☐ Other, please specify _____
- ☐ Other, please specify _____
- ☐ Other, please specify _____

7 **Which of the following does your company view as barriers to implementing an e-business solution? Mark all that apply.**

- ☐ Lack of shared technical standards
- ☐ Security issues
- ☐ Data protection or privacy issues
- ☐ Business messaging or transaction processing
- ☐ Cataloging and classification issues
- ☐ Initial cost is too high
- ☐ Time constraints
- ☐ Lack of skilled staff
- ☐ Readiness of business partners
- ☐ Lack of support from upper management
- ☐ Lack of proven business benefits
- ☐ Lack of direct customer contact
- ☐ Other, please specify _____
- ☐ Other, please specify _____
- ☐ Other, please specify _____
- ☐ Other, please specify _____

8 **Where does your company manufacture goods? Please Mark one.**

- ☐ **US only**
- ☐ **Abroad only**
- ☐ **Both US and Abroad**
- ☐ **No manufacturing facilities**
- ☐ **Don't know**

9 **Please provide any additional comments that you may have in the area provided below.**

Thank you so much for taking the time to complete this survey. If you would be interested in helping us further our research efforts through in – person, email or telephone interviews, or if you would like to receive a summary of the results of this study please provide your contact information below.

****In order to maintain confidentiality, this page will be separated from the rest of the survey upon receipt.**

☐ **I am not interested in participating in additional interviews, but would like to receive a summary of the results of this study.**

☐ **I would like to participate in further research. Please contact me by:**

☐ **Email: _____**

☐ **Telephone: _____**

Company Name: _____

Contact Name: _____

Address: _____

_____

APPENDIX F : THANK YOU POSTCARD

Last week, a questionnaire requesting information on how your company is using e-business was mailed to you. Your company was chosen because we are attempting to see how textile manufacturers in North Carolina are using the Internet to do business with their suppliers and customers.

If you have already completed and returned the questionnaire to us, please accept our sincere thanks. If not, please do so today. We are especially grateful for your help because only through asking people like you are we able to understand in which areas North Carolina textile companies are seeing the greatest returns and facing the biggest barriers when implementing an e-business strategy.

If you did not receive a questionnaire, or if it was misplaced, please call us at 919-412-1824 or email us at cmcagle@unity.ncsu.edu and we will get another one in the mail to you today.

Christy Cagle, Ph.D. Candidate and Research Assistant

George Hodge, Associate Professor and Director of Graduate Programs TATM
North Carolina State University
3244 College of Textiles Box 8301
Raleigh, NC 27695

APPENDIX G : FOLLOW-UP LETTER

«FirstName» «LastName»
«Company»
«Address1»
«City», «State» «PostalCode» «zip4»

About three weeks ago, I sent a survey to you asking about how North Carolina textile manufacturing companies are using e-business as part of a competitive strategy. To the best of our knowledge, the survey has not yet been returned.

We have received responses from a variety of North Carolina textile manufacturers, large and small, describing either their experiences with their e-business initiatives or their reasons for not using this particular resource. We think that the results of this study will benefit the US textile industry by providing information on how textile companies are using e-business with their trading partners and will lead to the creation of a model that will aid companies in deciding which e-business strategies are best suited to their company's needs.

We are writing again because your questionnaire response is important in order to get the most accurate picture possible. It is only through hearing from nearly everyone in the sample that we can be sure that the results are truly representative.

A few people have written to say that they should not have received a questionnaire because their company is not involved in textile manufacturing. If this applies to you, please let us know on the cover of the questionnaire and return it in the enclosed envelope so that we can delete your company's name from our list.

I emphasize that all information is **confidential**. All data will be reported in aggregate form to ensure that no individual companies will be identified. When you return your completed questionnaire, your name will be deleted from the mailing list and never connected to your answers in any way.

This survey is voluntary. However, your response would help us greatly. If for some reason you prefer not to respond, please let us know by returning the blank questionnaire in the enclosed envelope.

Your cooperation is greatly appreciated. Thank you very much for your help in this study.

Sincerely,

Christy Cagle
Doctoral Candidate

George Hodge
Professor and Project Chair

P.S. If you have any questions, please feel free to contact us via email at cmcagle@unity.ncsu.edu or via phone at 919-515-6579.

APPENDIX H : INTERVIEW REQUEST EMAIL

Dear _____,
This summer, you filled out a survey from NC State University on the use of e-business by textile manufacturers. You indicated on the survey that you would be interested in participating in further research. In order to further validate my research, I am interested in speaking with North Carolina textile executives about their experiences with e-business. I would like to come and visit your company and speak with you (and anyone else in your company that would like to participate) about your experiences and opinions on the subject of e-business. If you are interested in helping with this study, please give me some dates that you will be available so that we can schedule a day and time for the visit.
Thank you so much for your time!

Best regards,

Christy Cagle
NCSU College of Textiles
919-412-1824