

Project No. S03-AC01

Competency: Management Systems

## **Knowledge Management as Competitive Advantage in the Textile and Apparel Value Chain**

**Investigators:** Michael R. Solomon, Auburn University, [solommr@auburn.edu](mailto:solommr@auburn.edu); Basil G. Englis, Berry College, [benglis@berry.edu](mailto:benglis@berry.edu); Paula D. Harveston, Berry College, [pharveston@berry.edu](mailto:pharveston@berry.edu)

**Students:** Jennifer Davey, MBA Berry College; Marla Goldsmith, MBA Berry College

**Industry Partner:** Invista (previously DuPont Textiles and Interiors)



### **ABSTRACT**

Given the global nature of competition and the emphasis on cost, U.S. textile producers typically are unable to compete strictly on a price basis. The failure of many textile and apparel companies to differentiate themselves has had a negative effect on their profitability and viability throughout the value chain. The ability to store, capture and disseminate knowledge within and across organizational boundaries has challenged managers for many years. However, as product lifecycles have decreased and environmental complexity and volatility have increased, the textile industry's need to manage knowledge is intensifying. This project examines the process of acquisition, retention, maintenance, and retrieval of knowledge both within the firm through organizational memory and across the value chain. A series of case studies will examine how Invista manages knowledge internally and externally through relationships with downstream partners across a single value-chain within the textile industry. Qualitative interviews will assess the "state of the industry" regarding knowledge management systems. Based on the information gathered from the case studies and our review of the literature, we will develop a survey instrument and test the measures with our industry partner, Invista. We will initiate pilot studies using basic data and member lists obtained from the American Textile Manufacturers Institute.

### **GOALS**

Our goal is to fundamentally enhance the process of acquisition, retention, maintenance, and retrieval of knowledge both within the textile firm through organizational memory and across the firm's value chain to gain competitive advantage. Using the Invista value chain as an exemplar, our work (1) explores the relationship between low-cost and differentiation firm strategies on firm performance, (2) seeks to understand the relationship between firm strategy and use of different knowledge management systems, and (3) examines the impact of knowledge management systems on firm performance.

### **INTRODUCTION**

Firms view knowledge and knowledge management as part of their strategic orientation. Low-cost strategies may emphasize knowledge that can be used to cut costs, lower prices and shorten cycle times whereas differentiation strategies may emphasize knowledge that adds value to a product giving it unique characteristics that serve to differentiate it from the competition. This project investigates knowledge management in the textile industry in five ways:

1. The existing research on knowledge management is reviewed and key terms such as contexts and characteristics of knowledge are defined. This section ends with a discussion of internal and external knowledge management systems.
2. We examine the role of strategy and use examples from the textile industry to illustrate the importance of knowledge as a source of gaining and maintaining competitive advantage.

3. We consider the role of value-chain partners in sharing knowledge. We are particularly interested in examining external knowledge sharing that leads to developing or maintaining competitive advantage. For example, Invista's business strategy with regard to the Lycra brand (Lycra Assured) concentrates on linking brand benefit platforms across the value chain to gain critical mass.
4. We review extant knowledge management systems and introduce our model, which delineates the relationships and interconnections of knowledge management systems, strategy and firm performance across the value chain.
5. The preliminary results of case analysis involving Invista's Lycra Assured strategy are presented. This case study illustrates the differential strategic value of leveraging knowledge across the value chain to maintain strategic advantage. There are several competitive forces impacting the apparel division of Invista that make this study relevant. First, China's presence in the textile and apparel industry is growing rapidly, polyester technology is becoming socialized, and spandex expansion is increasingly aggressive (Pallerino & Williams, 2001). The first supply-chain management concept launched by Invista is Lycra Assured. It has been recently launched through the Lycra Accredited Mills program. This program utilizes a web-based knowledge management system that facilitates Invista's contact with every segment of the value chain. This increased contact should increase Invista's influence on the value chain to gain quicker time-to-market.

## **KNOWLEDGE AND KNOWLEDGE MANAGEMENT**

The quest to innovate through research and development is essential for firms to remain ahead or abreast of competitors. Indeed, many firms view the acquisition of new knowledge as a way to gain and maintain competitive advantage. However, few firms fully realize the benefits from such highly valued knowledge. Knowledge management extends beyond innovation. Knowledge that is isolated in one department or in one part of the value chain is not being used to its full extent. New knowledge should be harnessed and managed through internal knowledge management systems that create learning opportunities for other departments or product areas. Internal knowledge management systems may provide platforms for further development of knowledge transfer to external partners. By implementing internal and external knowledge management systems, firms can experience a greater competitive advantage and sustained success over a longer period of time.

Before we explore the construct of the knowledge management system, it is essential to define knowledge in this context because there are many definitions of the term. Davenport and Prusak (1998) describe knowledge as "a fluid mix of framed experience, important values, contextual information, and expert insight that provides a framework for evaluation and incorporation of new experiences and information." Of course, more than one type of knowledge exists. De Long and Fahey (2000) developed a useful framework to classify knowledge, which distinguished among human, social, or structured knowledge. *Human knowledge* is what humans know or know how to do. For example, this can be based on previous experience such as that of a sewing operator who has many years of experience stretching flawed pieces of fabric to fit together to create the final product (Abernathy, Dunlop, Hammond & Weil, 1999, 156-157). *Social knowledge* is usually tacit knowledge that arises out of relationships. An example of social knowledge is the way employees at different levels in the employment hierarchy interact with other employees (e.g. a cutter and a finisher versus a cutter and a manager). *Structured knowledge* is rooted in the systems, processes, rules, and routines of an organization and is usually explicit knowledge (De Long & Fahey, 2000). Within these classifications lie four additional dimensions (Garud & Nayyar, 1994). Table 1 shows the interactions of the three basic types of knowledge with these four dimensions:

1. Codifiability (explicit/tacit): Some knowledge is more easily codified. Explicit knowledge is knowledge that can be easily communicated to others, such as how retail inventory replenishment systems function. Tacit knowledge is more intuitive, generally learned over a long period of time, and not easily communicated to others such as the ability to develop new molecules with added value for the textile industry.
2. Simplicity/complexity: Simple and complex knowledge can be distinguished by the amount of information needed to communicate that knowledge. Simple knowledge requires little information, whereas complex knowledge requires a greater amount. An example of simple knowledge would be how to recognize cotton growing in a field, while complex knowledge would be how the chemical structure of Teflon adds value to cotton if applied to the fabric.
3. Systemic/independent: This dimension refers to the degree that knowledge is embedded within a system. Independent knowledge exists without a system whereas systemic knowledge is system-dependent. An example of systemic knowledge would be the manner in which information is shared as company meetings are conducted, whereas the chemical structure of Teflon is independent.
4. Velocity/viscosity. Velocity refers to the quickness of knowledge as moves through an organization while viscosity refers to the “richness” of knowledge (Bhagat, Kedia, Harveston, & Triandis, 2002). For example, news of impending layoffs travels quickly throughout firms; this would have high velocity. The knowledge needed to impart a new product development process to colleagues would be highly viscose.

**Table 1**  
Interactions of Knowledge Context and Characteristics

Knowledge Characteristics	Knowledge Context					
	Human		Social		Structured	
<b>Simple versus Complex</b>	Simple in human context likely to have faster velocity & lower viscosity.	Complex in human context likely to have slow velocity & high viscosity	Simple in social context likely to have faster velocity & lower viscosity.	Complex in social context likely to have slower velocity & higher viscosity	Simple in structured context likely to have fastest velocity & lowest viscosity.	Complex in structured context likely to have fast velocity & low viscosity.
<b>Explicit versus Tacit</b>	Explicit in human context likely to have faster velocity and lower viscosity.	Tacit in human context likely slow velocity and high viscosity.	Explicit in human context more likely to have faster velocity and lower viscosity.	Tacit in human context slowest velocity and highest viscosity.	Explicit in structured context likely to have fastest velocity and lowest viscosity.	Tacit in structured context moderate velocity and most viscosity.
<b>Independent versus Dependent</b>	Independent in human context likely to have faster velocity and low viscosity.	Dependent in human context likely to have slower velocity and high	Independent in human context likely to have faster velocity and less viscosity.	Dependent in human context likely to have slower velocity and more	Independent in human context likely to have fastest velocity and lowest	Dependent in human context likely to have slowest velocity and

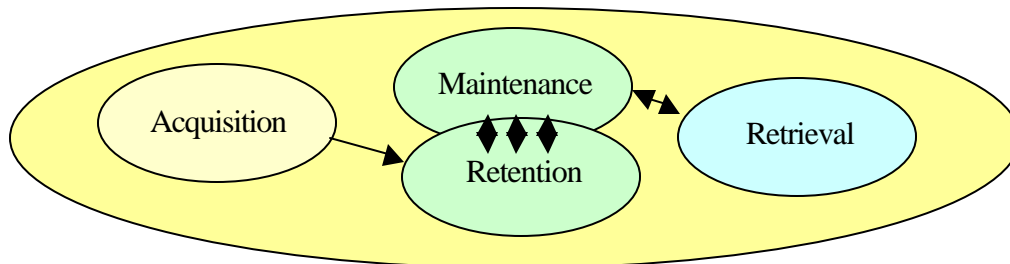
		viscosity.		viscosity.	viscosity.	high viscosity.
<b>Knowledge Speed/ Richness</b>	<b>Velocity</b>	<b>Viscosity</b>	<b>Velocity</b>	<b>Viscosity</b>	<b>Velocity</b>	<b>Viscosity</b>

As Table 1 shows, when knowledge is transferred in a human context, it is likely to be more tacit, more independent, have lower velocity and have high viscosity. The knowledge could be either simple or complex. Human knowledge exists in all organizations. In the textile industry, innovation is based on human knowledge through trial and error and years of experience. Invista (formerly DuPont Textiles and Interiors) recently announced a new version of Stainmaster carpet. In the new version fibers are dyed before being sent to the carpet mill. This ensures fade resistance and color uniformity. In order to excel in the textile marketplace, firms must learn how to effectively build, maintain, and control internal knowledge. Effective internal management of knowledge generally requires implementation a knowledge management system. Knowledge management systems help businesses to acquire, retain, maintain, and access knowledge within their organization and outside of their organization (Stein, 1995).

*Knowledge Management Systems – Internal Processes*

The effectiveness of building knowledge within the firm depends on the firm’s ability to monitor and absorb newly acquired knowledge from many sources and integrate this knowledge into its existing knowledge base (Cohen and Levinthal, 1990; Hamel, 1991; Hansen, Nohria, and Tierney, 1999; Leonard, 1995). Thus, firms must internally organize and manage existing knowledge. Internal knowledge management systems can also be thought of as organizational memory. Organizational memory is defined as “...the means by which knowledge from the past is brought to bear on present activities, thus resulting in higher or lower levels of organizational effectiveness” (Stein, 1995, p.22). Businesses can benefit from organizational memory by implementing knowledge management systems that help to organize and preserve the knowledge of a company. Establishing organizational memory via knowledge management systems is an essential task before firms venture into knowledge sharing with value chain partners. If internal knowledge management systems are not in place, then organizational learning will not take place and new knowledge will not be stored in organizational memory. Before developing knowledge management systems, businesses need to understand the process of organizational memory. As shown in Figure 1, this process is divided into four separate parts; acquisition, retention, maintenance, and retrieval (Stein, 1995).

**Figure 1**  
**Internal Organizational Memory**



Acquisition. Knowledge is acquired both internally and externally. The major source of internal knowledge acquisition for a business is through research and development. Researching new knowledge helps businesses develop new products and stay competitive in the market. In order for external

knowledge to be acquired, firms must research work that has previously been published or is otherwise available. For example, businesses that are developing a new product could research previous products that may be similar. Therefore gaining valuable knowledge as to whether or not the product will be successful.

Retention. Three mechanisms aid the retention of knowledge. These mechanisms include; schemas, scripts, and systems. A schema is defined as an “individual cognitive structure that helps people organize and process information efficiently” (Stein, 1995). Researchers describe schemas as information that is broken up into categories that share a structural characteristic (Stein 1995). In comparison, a script describes sequencing of events in familiar situations (Lord and Kernan, 1987). Organizations typically have particular procedures they follow in order to ensure production. For example, employees may have a certain procedure that they follow when they are involved in meetings. This procedure helps the employees to retain as much knowledge as possible. If each meeting followed a different procedure, employees might have a hard time concentrating on what a speaker is saying. At an organizational level, systems can be defined as elements that are connected either directly or indirectly (Ackoff, 1971). These information or knowledge management systems are typically databases that record knowledge for future use. However, an organization may have knowledge embedded within its social networks. An example of this is the “water-cooler” effect, which involves the informal verbal passing of knowledge between coworkers. The retention of knowledge from these informal networks typically is higher than the retention of knowledge from distributed information systems. However, knowledge is not easily maintained through informal networks and therefore must be documented in a knowledge database in order to be preserved for future use.

Maintenance. The maintenance of knowledge is very important to a business. If knowledge is not properly maintained, information could become misconstrued or lost all together. When information is stored within individual minds, the maintenance of this knowledge becomes complicated. For example, research shows that when turnover occurs, the organization loses the human component of that organization’s memory (Flamholz, 1974). When employees leave a company, they take valuable knowledge with them. When experts leave, a cost is presented to a company in the form of educating and training a new employee in order to produce an expert (Prahalad and Hamel, 1990). There are a few ways to combat this problem. For example, Cohen and Levinthal (1990) suggest that when employees leave, firm can preserve organizational memory by maintaining relationships with outside sources including using former employees as consultants. Also, by using communications networks, such as saving files on a server, information can be stored even when employees leave.

Retrieval. The retrieval of information is one of the most important aspects of organizational memory. Individuals must be motivated in order to retrieve information. A major problem within many organizations is that employees view knowledge as a method of securing their jobs and are reluctant to share information. Therefore, managers need to pay special attention to their organizations support of knowledge sharing in order to be successful. Ernest & Young, for example, evaluates and rewards its employees based on their contribution to the knowledge of the firm (Hansen, Nohria, and Tierney, 1999).

In order to successfully compete in today’s market, firms must learn to maintain internal knowledge. Internal knowledge maintenance is an important aspect due to the fact that firms that have learned to organize internal knowledge can thus share this knowledge with other firms. External knowledge sharing benefits businesses and consumers alike.

#### *Knowledge Management Systems – External Processes*

Knowledge is rarely shared between firms, even if they are in the same value chain. External knowledge management systems are often comprised of Internet based systems that link members of the value chain. For example, Dell has developed a business model that increases sensitivity among value

chain members to customer satisfaction (Teresko, 2001). Dell posts point-of-sale and demand forecast information online for all suppliers to access (Strausl, 2001). Dell's Internet postings allow suppliers to minimize channel inventory while emphasizing velocity and flexibility (Strausl, 2001; Teresko, 2001). On a functional level, external knowledge management systems are transparent and allow every member of the value chain to "see" the operations of every other member through production schedules, shipping schedules, ordering schedules, and inventory levels. At a strategic level, knowledge management systems when shared across the value chain bring the "voice of the consumer" very clearly into the process. This allows the entire value chain to view changing customer preferences. Early knowledge of changing consumer preferences creates opportunities for all members of the value chain to react almost immediately, thus reducing cycle time of product development and change.

External knowledge systems also bring value chain members closer together and add value to the product throughout the value chain resulting in products that are differentiated from low cost substitutes in the marketplace. Knowledge management systems can lower costs tremendously by increasing communication and eliminating steps in the manufacturing process that are either unnecessary or duplicated. Value chain partners can also experience rapid learning by jumping onto another's learning curve with particular processes or procedures such as Six Sigma Continuous Improvement. Knowledge sharing leads to increased quality and heightened customer perceptions of brand platforms. For example, by sharing information with supply-chain members, Dell Computer is able to offer consumers customized PCs with high-quality components at a low price. In 1997, Dell scored top scores in vendor image in a survey given by ComputerWorld. Dell also scored high scores in performance and quality (Gagne, 1997). External knowledge sharing is becoming increasingly important as international competition increases and value chain boundaries become hazy. There are many benefits that can be gained by sharing knowledge throughout the value chain resulting in higher productivity and profit

Proactive knowledge management systems reap the benefits of reduced costs and cycle time, but they also link the voice of the consumer to all stages of product development, production, and distribution. For example, Invista currently hosts an online fabric library that is accessible to anyone, not just those firms that are already members of its value chain. This database is the largest, best-used online fabric library with over 22,000 fabrics from 500 mills in 64 countries. Interested apparel makers can check if Invista is able to fulfill an order before placing that order and to sample a variety of fabrics blended at the mills. Apparel makers and Invista benefit from this system. It allows Invista to further understand the needs, durability, breathability, and quicker drying times of apparel makers, and allows Invista to work to improve its fabrics to meet those needs. Both parties benefit from drastically decreased time-to-market, decreased expenses for outsourcing fabric, and increased product usage.

### **Types of Knowledge Management Systems**

There are two general types of knowledge management systems that firms use to provide a basis for renewing competitive advantage. Passive knowledge management systems (such as the EDI system used by Wal Mart) are distinguished by their orientation to the "present" and tend to be used with channel members such as suppliers to more closely schedule component deliveries, reduce cycle time, cut inventories, and decrease the overall costs of production based on current behavior of buyers and sellers.

In contrast, proactive knowledge management systems (such as Molex's integrated knowledge management system in the automotive industry) have a "future orientation" and tend to be used with channel members to add value to the product as it passes through value chain. Proactive knowledge management systems reap not only the benefits of reduced costs and cycle time, but also develop valuable knowledge that anticipates of future buyer/seller behavior (e.g. market back R&D). Proactive knowledge management systems do not simply enhance efficiency through time and cost savings. They also provide a way to link and leverage the "voice of the consumer" to all stages of product development, production and

distribution through the value chain. While anecdotal evidence suggests that some firms are building knowledge management systems that include both proactive and passive systems to provide feedback loops throughout the value chain, there is no empirical research relating these developments to strategy, value-chain position, and performance.

### **Firm Strategy**

Porter's (1980) generic business strategies are a widely used typology that identifies potential routes to competitive advantage within an industry. Two such strategies are of particular relevance to the apparel and textile industry: (1) a *cost leadership* strategy, which requires a firm to emphasize those variables that allow it to achieve and maintain low per-unit costs; and (2) a *differentiation* strategy, which is based on creating a unique image or value for a product or service. Furthermore, a review of the literature applying Porter's framework of generic strategies leads us to the conclusion that the U.S. textile and apparel industry is most likely to pursue one of two primary types of differentiation strategies: (1) *market-based differentiation* where an organization seeks to set itself apart from the competition primarily through product positioning, or (2) *innovation-based differentiation* where the organization attempts to differentiate itself through innovative application of technology to meet customer needs.

In the first (more common situation), the firm closely monitors competitors so that it can differentiate its goods or services from those of its rivals. In contrast, innovation-based differentiation is less concerned with positioning against the competition and more with developing entirely new markets. This strategy is successful only insofar as the innovation appropriately anticipates future market/customer needs, desires, aesthetics, etc. It has great potential for the textile industry, as it is not based simply on brand differentiation, but rather on creating a shared and dynamic "knowledge network" throughout an integrated value chain. This network in turn can enhance the flexibility and profitability of the value chain, enabling anticipation of changing market dynamics and more effective new product innovation to meet those market changes.

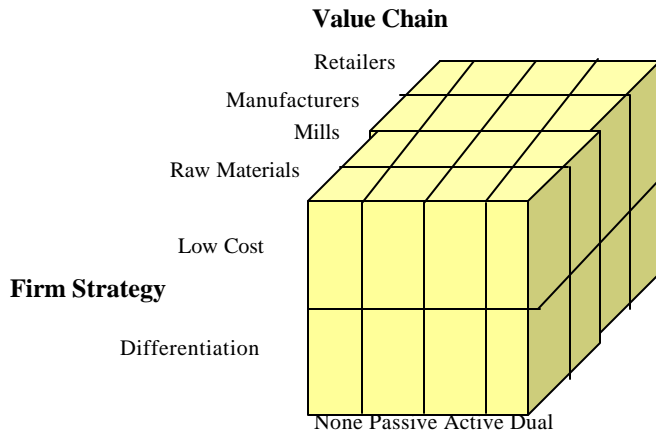
### **Value Chain Position**

The concept of industry value chains reflects the value-added, natural sequence of operations or stages in a chain of supply (Porter 1985). The value chain in the textile and apparel industry begins with a raw material extraction or production stage (i.e., harvesting cotton, or developing new synthetic fibers) that supplies the second stage of primary manufacturing. The second stage usually produces a standardized output of commodity material (fibers and fabrics) used to fabricate commodity products. Progressing downstream, commodity products from the previous stage are used by manufacturers, who apply product development technologies, patents, and proprietary features to further add value. The next stage includes marketers of consumer products, followed by distributors and finally, the retailers who sell to the final consumer. The stage a firm occupies along its industry's supply chain has important implications for its strategy development and, therefore, its ability to compete.

Porter (1985) cites a number of ways that firms can leverage linkages across their value chains to reduce cost, increase performance and be more effective. These leverage opportunities include: performing the same function in different ways (e.g., specifying close tolerances), improving the cost or performance of indirect activities (such as improved delivery time based on servicing customer needs gained through online data), reducing the need to demonstrate, and explaining or servicing a product in the field by performing these activities within the firm (such as co-design with customers through Internet-based platforms). Only recently have knowledge management systems as a means of aligning and optimizing value-chain relationships received attention by textile researchers (cf. NTC Project #I99-S10).

### **The Knowledge Management Model**

Figure 2 shows the interaction of firm strategy, value chain partners, and knowledge management systems. Currently we are in the process of: (1) examining a specific segment of Invista's value-chain (i.e., manufacturers), (2) conducting qualitative interviews to assess "state of industry" regarding knowledge management systems, (3) identifying firms using each level of the knowledge management system, and (4) designing a survey instrument and test measures via a pilot study within the textile and apparel industry.



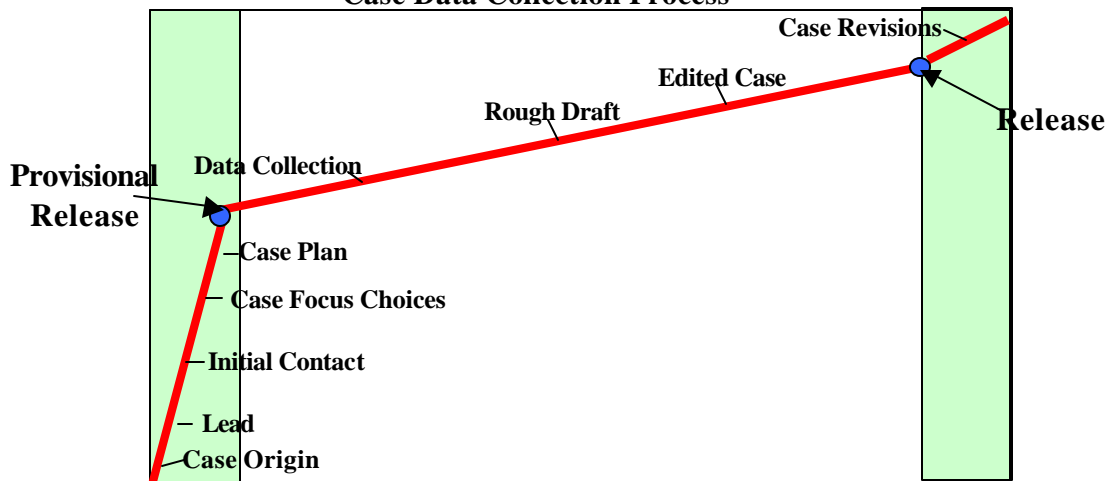
**Figure 2. Knowledge Management Systems**

**Case Study Update**

As mentioned in the introduction, we are in the process of examining Invista's knowledge-sharing initiatives that link the value chain, brand benefit platforms, and critical mass. Invista touches every segment of the value chain, and web-based systems are expected to facilitate value chain influence, create value-added product infusion, and obtain quicker time-to-market. Two programs currently under exploration are the Lycra Assured program that originated with Lycra Accredited Mills and the online fabric library.

With regard to case analysis, we are very interested in examining the relationship between Invista DTI and one of its downstream clients. Downstream clients have specific fabric requirements in terms of fabric soil resistance, fabric longevity, breathability, toughness, ability to withstand multiple cleanings, quicker drying times, etc. By sharing the downstream partner's customer fabric requirements and creating market back knowledge creation opportunities for Invista, both companies can benefit from increased product differentiation, decreased time-to-market, decreased costs and increased product usage which combined creates increases profitability for both companies. The case data collection process is shown in Figure 3.

**Figure 3  
Case Data Collection Process**



**Phase 1**

**Phase 2**

**Phase 3**

(Adapted from Leenders, Mauffette-Leenders & Erskine, 2001)

We are currently in the process of completing Phase 1. We have secured Invista as an industry partner and are now investigating downstream case partner possibilities with its cooperation. These potential partners include Shaw Industries, Inc., The Limited, Lion Apparel, Liz Claiborne, Alexander Julian, and Fenaroli for Regalia. We are also conducting extensive discussions with key personnel at CINTAS.

**Summary**

The goal of our project is to fundamentally enhance the process of acquisition, retention, maintenance, and retrieval of knowledge both within the firm by improving organizational memory and across the value chain through knowledge management systems to gain competitive advantage. Through this process we will gain understanding of how business level strategies and the use of different knowledge management systems across the value chain impact firm performance in the textile and apparel industry.

This research project will also help partners to examine their knowledge management systems both internally and externally. Internal systems create and sustain organizational memory. Organizational knowledge such as routines and processes are more easily stored whereas tacit knowledge of key individuals is much more difficult to codify. Organizational memory creates opportunities to minimize knowledge isolation in functional departments and creates a greater base for tacit learning to be leveraged. Firms with robust organizational memories are less impacted when key personnel turn over. External knowledge management systems bring value chain members closer together and add value to the product (i.e., increased quality, customer perceptions of brand platforms) throughout the value chain. The opportunity for innovation increases as partners discover new possibilities or combinations from their input in the value chain process. These opportunities may decrease costs of products or create innovative applications for mature products. The overall impact of knowledge management systems engaged across the value chain is to differentiate products from low cost substitutes in the market place and create sustainable competitive advantage for all partners.

**Project Website:** <http://campbell.berry.edu/faculty/pharveston/ntc.htm>

**Project Statistics**

- # graduate students involved in the research: 2
- # presentations: 4
- # publications: 4
- # papers submitted (not yet published): 2
- # contacts with industry: 3
- # contacts with academic (non-NTC), including those in other disciplines in the same university: 5

**Grant-Funded Research Presentations**

Bhagat, R., Kedia, B. Harveston, P. and B.N. Srivastava (2003), Creation, transformation and flow of knowledge across the individualism–collectivism divide: Implications for multinational corporations. *Proceedings of the European International Business Academy*, Copenhagen, Denmark.

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