Southeastern Region

Forward to the Future: The Transition to Agile, Quick Response Manufacturing

Textile/Clothing Technology Corporation [TC]² shows how to step sprightly.

Textile/Clothing Technology Corporation
National Apparel Technology Center

Larry Fredendall

Hunting for jack rabbit-quick responsiveness in your key markets? A consortium called Textile/Clothing Technology Corporation [TC]² offers a working model of agile, quick response (QR) manufacturing. [TC]² shared their "lessons learned" about moving away from large-scale production toward more competitive ways to meet changing customer demands during a recent North Carolina workshop (see the box, "About [TC]²."

[TC]²'s vision is to be the technological focal point for the soft goods industry, from the retailer's cash register to the fiber manufacturer. The consortium intends to play a pivotal role in transferring applied technologies to the sewn products sector through demonstration, education, and research and development (R&D) projects. [TC]² is concentrating first on reducing the non-value-added handling costs in the apparel industry. These costs account for 27 percent of each sales dollar (labor accounts for only ten percent).

Agile Manufacturing

Agile manufacturers achieve competitive advantage using information to make decisions at the last possible moment — decisions carried out by an empowered, cross-trained work force. Becoming an agile apparel manufacturer is not straightforward, as shown in Figure 1.

Agile manufacturing requires four components:

1. Flexible technology
2. Information networks
3. A knowledgeable work force
4. Industry partnerships.

No individual component of agile manufacturing can be fully implemented until the others are in place. For example, industry partnerships cannot fully develop until flexible technology is required. To make flexible technology cost effective, the partners must fully utilize its capabilities, which requires an information network between the participants. Otherwise, speed gained during the manufacturing process is lost through slow information transmission. For a firm to capitalize on both flexible technology and an information network, it must have a knowledgeable work force. In turn, the expense of recruiting and maintaining such a work force is cost effective only when there are industry partnerships to reward agile manufacturing.

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About [TC]²

The Textile/Clothing Technology Corporation [TC]² is a not-for profit consortium of fiber, textile, apparel, and retail enterprises. Through demonstrations, education, and research and development, its members seek a more competitive soft goods industry.

The group operates a large-scale demonstration of quick response (QR) using unit production systems and flexible manufacturing. Through a partnership with 52 locations of Mercantile Stores, [TC]² produces women's pants for the stores using point-of-sale information and fabric supplied by Milliken & Company. The QR demonstration reflects EDI use for purchase orders, advance ship notices, invoicing, and fund transfers. It operates on a weekly turnaround basis but is heading toward daily replenishment; orders received daily from Mercantile are shipped in three to five days. The program demonstrates industry requirements and benefits of a fully-implemented QR program. Participation in industry trade shows enables [TC]² to introduce new concepts and reach large audiences in a short time span (the consortium offered a QR demonstration during the AME 1993 annual conference in Nashville, TN).

Improving textile industry competitiveness is essential, [TC]² said. Fifty percent of the $149 billion spent annually by U.S. consumers is for imports. In addition to the impact on the balance of trade, this competition affects the prospects for one million U.S. workers employed in the apparel industry.

[TC]² is working with a consortium of fiber, textile, apparel, labor, government, and academia to identify barriers to needed business partnerships. They also seek to develop and commercialize technology for flexible manufacturing and communications through information networks and to test new methods of creating and using a more knowledgeable, empowered work force.

The Teaching Factory

[TC]² created a "teaching factory" to demonstrate new technology, educate the industry, and conduct R&D. They view it as a catalyst for the creation of a competitive, highly-technological, U.S. manufactured sewn products industry.

This teaching factory has demonstrated, educated, and sponsored R&D in each of the four components of agile manufacturing for industry groups, private companies, students, and others. It provides seminars and workshops on and off-site.

Flexible Technology

The teaching factory operates a production line eight hours a day, producing multiple products for different retailers. In 1988 the leadtime was 14 weeks, using the traditional batch system. Agile manufacturing techniques allow it to receive an order, cut, sew, package, and ship within one week. [TC]²'s goal is to receive the retailer's point of sale information one day, then cut, sew, and ship within three days.

... the ergonomic design of the new adjustable sewing work stations protects and preserves the firm's investment in human capital.

Gloria Harris, an industrial engineer at [TC]², said the ergonomic design of the new adjustable sewing work stations protects and preserves the firm's investment in human capital. For example, when an operator who works at 120 percent efficiency slows down just ten percent, the operator is producing 64.8 minutes' worth of work every hour instead of 72 minutes' worth. The firm then loses 57.6 minutes of productivity per day or 14,976 minutes a year! If the typical garment has four minutes' worth or work content, the business loses 3744 garments in a year due to that one operator. The three risk factors for cumulative trauma disorders (CTD) are extreme postures, application of force, and repetition. The ergonomic sewing machines have foot pedals to adjust and operate the machine, allowing the operator to change posture easily. When workers are cross-trained, repetition is reduced as they move from one task to another throughout the day.

[TC]²'s unit production system (UPS) increases operator productivity 18.4 percent. With UPS, all garment pieces are initially attached to a hangar. An overhead conveyor takes the individual garment from station to station in the correct sequence. UPS reduces the direct labor content by reducing material handling, and it improves quality by allowing quick feedback between operators to handle problems quickly. Further cost reductions are achieved by organizing operators into a team. The team plans the production sequence, operates the machines, and assigns operators to certain machines. The UPS automatically gathers data to track orders, costs, and equipment utilization, which helps to reduce costs.

Creating the Agile Marketplace

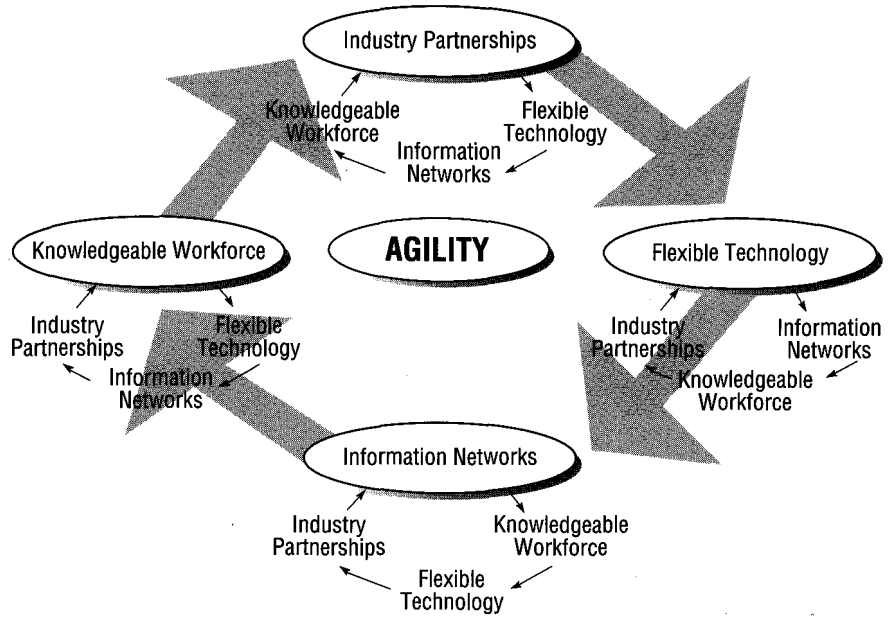

Figure 1. *Successful participation in the agile marketplace is not a straightforward path. Required elements, according to [TC],² include flexible technology, information networks, knowledgeable workers, and industry partnerships. No individual component of agile manufacturing can be fully implemented until the others are in place.*

R&D Projects

R&D projects are essential to the industry's development of flexible technology. All R&D efforts at [TC]² must meet four criteria. They must 1) be directed to specific industry needs, 2) have potential for commercialization, 3) be aligned with the vision of apparel-on-demand through agile manufacturing, and 4) result in cost-effective solutions and strategies.

To increase the rate of innovation, [TC]² avoids the "not invented here" syndrome, and, if possible sub-contracts the development work on its R&D projects to private industry. One example is the "skipped stitch detector" (a small device attached to the sewing machine head that beeps when a stitch is skipped) to ensure that no stitches are missed. The single-needle, single-thread version sells for $525 and the four-needle, four-thread version sells for $850. The detector will be sold to industry by private industry partners as a cost-effective method to improve

quality and improve productivity (eliminating the need for inspectors and rework).

Another example is the "felled seamer" for jeans; it automates the different felled seaming operations. It's under development to improve stitch quality and repeatability by improving the consistency of fabric overlap. It will also reduce operator fatigue and CTD injuries by eliminating repetitive motions, consequently improving productivity.

Jud Early, [TC]²'s R&D director, said an optical measuring system is being developed to allow patterns to be customized to individuals. In this system, the customer steps into a booth, where they are scanned with white light. Instruments digitally record and store the customer's measurements. The information then can be combined with the a digitalized garment pattern and sent to the cutter to begin the manufacturing process.

[TC]² is adapting simulation software for use in the apparel industry. Barbara Mazziotti, manager of simulation services, pointed out that a simulation is merely the translation of the process flow chart into a computer program, used in many industries to test systems and reduce risk, thus eliminating cut-and-try methods. It also allows decision-making practice and development of realistic estimates for random factors such as absenteeism or late deliveries. [TC]² prepared a generic simulation of an apparel factory in SIMAN that allows a company to input its own process steps and capabilities eliminating the need for a staff expert in a given simulation language.

[TC]² also is helping the industry to develop inexpensive radio frequency (RF) tags that can be sewn into a garment. The RF tag will contain individual garment information allowing it to be tracked through the supply chain, reducing non-value-added storage and handling costs. It will help to prevent garment counterfeiting, reduce inventory, and assist the dry cleaner.

Information Networks

Each company in the supply chain can gain competitive advantage by gathering and then sharing this information. Apparel industry trade groups have established necessary communication standards to do this through electronic data interchange (EDI). To demonstrate the potential of the information network, [TC]² directly connected a cash register to the shop floor. Each person on the tour first went to the cash register where customer information was obtained (their selection of size, color, and their initials). This information was immediately transmitted to a modular sewing line, where sewing specialists assembled the product, the initials are automatically embroidered, and delivered the shirt to each "customer" within minutes.

Figure 2. *Sewing specialists at the [TC]² National Apparel Technology Center produce T-shirts in a stand-up, hands-off sewing module, demonstrating the effectiveness of modular manufacturing techniques.*

Knowledgeable Team-Based Work Force

To obtain the knowledgeable work force needed for flexible technology, [TC]² organized workers into teams. Angela Taylor, a member of the sewing specialists team, said that her team meets one hour a week to set goals and discuss problems. One problem the team recently discovered and resolved was that the neck holes on T-shirts were being cut too large.

Another example is the support staff team. Maria Muniz, a team member, discussed how difficult it was for the staff to make the transition into a team. It required cross-functional training and the development of respect for other team members. One cost savings the team achieves is reducing the need for temporary help; team members help each other when there is a surge of work in different parts of the organization. They meet every two weeks for 1.5 hours to discuss problems and set goals.

Self-directed teams in manufacturing increase employee involvement, in turn reducing costs by flattening the organization. But the industry's dominant reward system — piece rate pay — doesn't foster worker cooperation. To address this challenge, [TC]² uses a pay-for-skill system and rewards on the basis of both group productivity and plant productivity. Gloria Harris said that the traditional piece work pay system may allow workers to receive the gains of increased daily production, but it also encourages repetitious movements and therefore increases the risk of CTD injuries and employer risk for related payments.

Success with new technology requires a

Figure 3. *Richard Atwell, senior industrial engineer at the National Apparel Center, explains [TC]²'s unit production system (UPS) configuration, used to make shirts and skirts for Lucia.*

"learning environment." [TC]² invests in various types of training. Some team members receive training in conflict resolution, team leadership skills, how to conduct productive team meetings, etc. [TC]² stressed that it is important for employees to assume responsibility for continual learning.

Success with new technology requires a "learning environment."

For example, Maria Muniz explained that a second team she is on sponsors "Learning Lunches" once a month. Here, team members from [TC]²'s manufacturing department meet over lunch to discuss a book they all agreed to read. Typical subjects are teamwork, quality, or customer service. Different team members lead the discussion each time. It is their responsibility to ensure that the discussion identifies ideas which can be applied at [TC]².

[TC]² also demonstrated the effectiveness of interactive video training in training mechanics and operators. More than 30 programs show how to take apart, reassemble, adjust, and operate a variety of industrial sewing machines. This self-paced training provides verbal and visual information through full-motion video and three-dimensional animation. Following each lesson, there are questions to test for understanding. Each time a wrong answer is given, the program replays the correct procedure. A course administration system tracks a student's progress. Following initial training, the programs also can be used for ongoing troubleshooting of any machine problems.

Interactive training systems draw high marks. Tony Parker, a machine technician, said when he first started in the industry, all training was provided on the job by a senior mechanic. He said interactive training helped him to learn a number of key steps to keep machines running smoothly, an improvement over the old method.

Interactive training systems draw high marks.

Frank Hughes, head of the department producing these programs, challenges all industry mechanics to evaluate interactive training by bringing their problem machines with them when they come to [TC]². Seeing is believing!

Industry Partnerships

Will Duncan, QR manager, said the most difficult task of QR manufacturing is to develop partnerships throughout the supply chain. Partnership means jointly setting goals and developing a plan to meet those goals. Partners need to provide the right product to serve the end customer faster. Although technology to support these partnerships is available, issues about sharing risk, etc. need examination. The concept is that members of the chain reduce risks by sharing information.

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