PENNSTATE

A D V A N C E D

Manufacturing Forum

Center for the Management of Technological and Organizational Change (CMTOC)
The Mary Jean and Frank P. Smeal College of Business Administration

December 1997 405 Beam Business Administration Bldg., University Park, PA 16802 (814) 865-1789

Competitive Strategy and Manufacturing Management October 29-30, 1997

A Five Year Perspective on Lean Systems

Melissa F. McCoy, Assistant Director
GROWTTH and Lean Systems Implementation
Freudenberg-NOK General Partnership

Background

Freudenberg-NOK is a German-Japanese partnership and the world's largest producer of elastomeric seals, gaskets and custom molded products. In 1991, Freudenberg-NOK was under pressure from customers, such as Chrysler, to cut its prices. If the company failed to cut prices, it would lose market share. But if it simply cut prices, then profit margins would erode. In order to prevent profit margin erosion, the company had to cut costs as well as prices. One area to reduce costs was on the production floor.

Implementation

The company's strategy was its trademark process called "Get Rid of Waste through Team Harmony" (GROWTTH). It used this process to implement lean manufacturing systems - or, in other words, the Toyota Production System (TPS) - on the production floor.

As a preparatory step to implementing this process, Freudenberg-NOK's CEO announced to everybody in the company that the GROWTTH process would become the primary means to cut costs and survive in the industry. He also assured all employees that nobody would be displaced as a result of implementing the new process.

The major focus was to convert production processes from conventional manufacturing to lean manufacturing. In conventional manufacturing, as a piece or a batch goes through different jobs such as molding, trimming, inspection and packaging, it has to sit and wait in a separate area for a considerably long period of time between jobs. This method requires involvement of multiple operators. In lean manufacturing, however, all of these separate jobs are brought together as close as possible in U-shaped cells called "model cells" where, in most cases, only one operator is involved. Also, instead of a batch-flow type of operation, there is a combined one-piece-flow operation.

In order to undergo conversion from conventional to lean manufacturing, the company used the kaizen process as a tool. A kaizen is a three to five day team project which involves eight to ten people who concentrate on a particular process in order to eliminate waste and to implement elements of TPS. The significance of kaizens is that they are undertaken in a series. A few months after the first kaizen project, a second and possibly a third kaizen project is initiated to achieve small incremental improvements. This means that the company is dedicated to continuously improve its processes and reduce costs through multiple kaizen processes. As an example, the company did a repeat kaizen on its gasket production process in 1995. Before the selected team did the first kaizen project, 38 workers were involved in the production process. Every worker produced 48 pieces and the production occupied 2000 square feet. After the first kaizen, the team was able to reduce the number of workers to 24 and to increase the productivity per worker to 83 pieces. After repeated kaizens were conducted within a year, the number of workers and production space was reduced to 12 and 700 square feet, respectively, and waste was cut by 50%.

The company also utilized a process called "blitz." A blitz is an extremely concentrated effort to create breakthrough results in a facility that has considerable experience with the kaizen process. During a blitz, several teams conduct multiple kaizen projects on a cell within 10 to 12 weeks to convert as many cells in that particular facility into U-shaped model cells as they could. This

conversion was the last step of TPS. The company used outsiders, e.g., customers, suppliers, in its kaizen teams because they were usually able to see different aspects of processes than did the company's employees. As an example, a "blitz" took place in the Bristol facility, which is the company's oldest and largest facility with 12,000 employees. The facility already had previous significant experience with kaizens. Many teams had performed kaizen projects in this facility since 1992. The kaizen teams focused their efforts on improvements in production space, number of workers and equipment. These were the critical issues for the facility's future. Approximately 130 kaizen projects took place in 15 weeks and the team members from other facilities, and customers at times, donated 300 man-weeks of kaizen time. As a result of the "blitz," teams managed to free up space and equipment to support a 60% increase in Bristol production. They were able to convert every cell in the facility into a model cell achieving a 100% model cell implementation. They freed up 30,000 square feet of floor space and reduced work-in-progress by 50%. They also achieved a 25% reduction in scrap.

Results

Through GROWTTH, Freudenberg-NOK was able to make total net savings of $24 million through significant reductions in cost of quality by reducing waste and going from batch production to one-piece-flow production. However, as of 1997, 15% of the company's production remains in large batches, so there is still room for improvements and cost reductions. Also, as a result of GROWTTH, components produced per year almost doubled from 1992 to 1997. This is due to the reductions in production floor per job, which freed up space for more production in the company's facilities. Parallel to the increase in production, the company's sales increased from $300 million in 1992 to $680 million in 1996. Also, sales per employee more than doubled within the same period. The reduction in batch sizes led to a 50% decrease in inventory because work-in-progress inventory was now much less than what it used to be before the implementation of GROWTTH. Cost of quality went down by almost 60% and that led to one of the most important improvements achieved by GROWTTH—a 14% increase in variable profit margins despite the increase in costs of implementing an increasing number of kaizen projects every year. Basically, this increase was what the company was expecting from GROWTTH, since this gave it the flexibility to cut prices as its customers wished. Some other benefits of the program were a major reduction in accidents per employee and a 100% increase in sales per employee.

A Manufacturing Methodology for a High Product Mix Environment

Thomas H. Lemley, Plant Manager
Pittman Division of Penn Engineering and Manufacturing Corporation

Background

Pittman, a division of Penn Engineering and Manufacturing, is in the business of custom designing and manufacturing sub-fractional horsepower direct current servo-motors. The major markets that Pittman serves are medical and biomedical products, mass storage devices, computer peripherals, factory automation, packaging, graphic imaging and currency handling. The company began manufacturing sub-fractional horsepower DC electric motors in 1934. In 1958, it entered commercial and industrial markets by introducing new concepts in DC motor design. Penn Engineering and Manufacturing Corporation—a world leader in the fastener industry—acquired Pittman in 1970 and made it a division.

The company was very successful in pioneering new types of DC motors until the early to mid 1980's when they started to experience intense competition from offshore, world-wide motor suppliers. The first push toward a change in the company came from the company's customers such as IBM, Hewlett Packard, Xerox and Kodak. These companies wanted Pittman to be more flexible and reduce their prices and their lead time. Since these companies were the most important among all of Pittman's customers and were the driving power in the industry, the company had to comply with their expectations. The above mentioned factors obliged the division to act soon in order to keep market share and continue to be profitable.

Implementation

Since customers wanted a greater variety of products, Pittman's solution to their problem was to implement Demand Flow Technology®. DFT is a proprietary method that maximizes customer service and quality, and minimizes cycle time and

labor content. This meant that the division would manufacture its products by order rather than by demand forecast. In other words, they would not manufacture anything unless they received an order.

This strategy required that their tools be highly flexible and semi-automated in order to be able to make adjustments in accordance with the product specifications mentioned in the incoming order. The best way to tackle this requirement was to use Flexible Manufacturing Systems (FMS), which is an automated manufacturing and assembly system consisting of several machine cells and material handling linked together with sensors, LANs, and computers and integrated under the control of a computer. Since implementing DFT, Pittman has averaged between 50 and 100 discrete product configurations per week.

Before DFT was implemented, Pittman looked at how other job shops in the industry were defined. Pittman defined itself more as a job shop that manufactures commercial grade custom products in medium to high product mix and high volume. Next, they began searching for an appropriate production method. They learned that a production line approach would not work for Pittman because it would not allow flexibility, i.e., configuration changes would take a long time. They determined that islands of automation methodology, which utilizes automated manufacturing cells in conjunction with manual or semi-automated manufacturing operations, would only work for a medium product mix environment.

After the assessment mentioned above, the division decided to use DFT, which is based upon a production flow process that uses "visual kanbans" to pull material into and through the production process as the material is consumed. This is a flexible pull system that views a product as a "pile of parts" that is pulled through a sequence of steps where people or machines perform the work to create the product. Each manual, semi-automated or automated operation that is used in this technology is tooled for all possible product configurations and allows for fast configuration changes. This methodology also allows multiple product configurations to be manufactured simultaneously. In fact, Pittman can assemble four discrete products simultaneously since they have five demand-flow assembly lines. Operators can be moved from machine to machine according to what kind of configuration is required by the incoming order. Self-managed teams on the operation floor micro-manage the order flow process and schedules daily.

To implement DFT in their facility, Pittman formed an executive team and provided team members with off-site training. Some team members were eliminated during training when they were unwilling or unable to accept this major change. Next, the company used internal trainers and consultants to train their middle level managers and production operators. The training consisted of demand flow and team training as well as communication and problem solving training. This process went on from 1990 to 1992. Within this period, the division had to cut margins to keep its customer base and keep a certain level of finished goods inventory—something that they had never done before—in order to give the customers the flexibility that they were asking for.

Results

Since the launch of DFT, Pittman's sales and productivity (sales per employee) went up by 67% and 27%, respectively. Manufacturing lead-time, work-in-process inventory, raw material inventory, and sub-assembly lead-time decreased significantly. Indeed, the average final assembly lead-time went from five days down to five minutes. All of this happened between 1992 and 1996. The DFT assembly line first-pass yield rate was 99.98% and customer return rate was only 0.4%. DFT also allowed Pittman to assemble 43 discrete configurations per day without charging their customers higher prices.

Leading Teams Through the Lean Manufacturing Conversion

Doug Broughman, Plant Manager
Gelman Sciences

Background

Gelman Sciences is a wholly owned subsidiary of Pall Corporation, which is the world leader in the field of filtration and separations. Gelman has a spectrum of thousands of product configurations ranging from cartridges, capsules, and membrane discs to syringe, ophthalmic, and intravenous filters. The company is recognized for developing and manufacturing more kinds of membranes in more kinds of devices than any other firm in the world.

Its products for filtration and membrane separation are used in laboratory research, high technology manufacturing and critical medical applications. Five hundred products take up approximately 80 percent of its business. It sells directly to customers, through distributors, and to OEM suppliers. In its plants Gelman utilizes a variety of different production strategies such as make-to-order, make-to-stock, continuous replenishment or a mixture of these depending on the markets served. This requires that its manufacturing facilities and technologies range from high volume to labor intensive, low volume environments.

Although the plant did not seem to be in an immediate crisis situation, the management recognized that its overhead costs were high and the plant would not be able to remain competitive in the long run if management did not take action to lower the plant's costs. Therefore they decided to implement a process that they called Continuous Improvement (CI).

Implementation

The plant started the Continuous Improvement process in May 1993. The first stage involved supervisors and managers going through six months of training on "employee empowerment," which was the core subject of the program. The major focus of the training program was to instill in management the idea that this program was not a short-term "program of the week" but a long-term strategy. The goal was to get 100% support of management before introducing the concepts to the hourly workforce. As a result of this training, most of management came on board and agreed to support the program and the rest were asked to leave or were transferred to other plants.

Training was led by a relatively small outside consultant company. Some of the major topics covered were a general overview of the Continuous Improvement process, team formation, leadership, employee recognition, the changing role of managers and supervisors, and motivation for leaders. Also, one of the subjects discussed was "the ten things you must do to successfully implement CI through teams" which included management commitment and involvement, recognition of necessary cultural changes, empowerment of everyone in the plant and recognition of the need for intense employee training.

The workers first encountered the CI team concept at a plant-wide meeting that all shifts and managers attended. This way, everyone working in the company was able to get the same message. To stress the long-term commitment to CI, the operators went through core training for 12 months on a basis of two hours per month blocks. The three major concepts covered in the training schedule were "Creating the Team," "Establishing Problem Solving and Process Improvement Methods," and "Becoming Effective with People." The management also went through a 14 week training program in lean manufacturing concepts concurrently with the operators. During this training, management decided that forming teams around common operations, which was the original practice, was not optimizing the entire product flow. As a result, they decided to let teams focus on maximizing the entire product stream as opposed to local optimization.

At first, almost everyone in the company was concerned about the changes that the new program required. Workers were now supposed to tackle and solve problems that normally would have been handled by management. Worker resistance toward change was due to concern that they were being trained for a process that might result in losing their jobs. Management responded to this concern by guaranteeing that no jobs would be lost as a result of the CI program. However, no additional compensation or incentives were given up-front. The Finance and HR departments wanted management to demonstrate first that the CI program would save the company money. Thus workers received non-monetary rewards, such as verbal or written recognition, gift certificates to local merchants, tickets to football games, additional paid time off, etc. Currently the recognition program has come to a point where anyone in the plant can suggest another team or person for recognition. A steering committee was formed to monitor the recognition process.

In August 1995, management introduced a gain sharing program that related plant performance to key company goals. The Finance and HR departments supported this program. According to the program, plant performance was linked to pay-outs to workers, which were made quarterly. The program was extremely successful in helping everybody to focus on the plant's improvement process and in rewarding the work force financially. Twenty-five percent of savings were paid out to employees. The plan is updated every year to keep

the reward program in line with current goals and objectives.

Another issue that had to be tackled by the management was the "program of the week" mentality. Management responded to this by emphasizing that the CI program was long-term and everyone in the company would have to make short-term sacrifices to reach the long-term objective.

One important aspect of the CI program was that the role of management changed from "command and control" to "facilitate." Barriers between management and employers were eliminated and supervisors were encouraged to communicate with workers and teams in order to resolve conflicts. As a part of the empowerment concept, everybody should have as much information as possible including all workers further down the chain.

Results

The implementation of the CI program showed that during a program that required change, management support and commitment, training and support after training were critical factors. Also, short-term sacrifices may be needed in order for changes and improvements to be sustained in the long-term.

As a result of the process, some major improvements could be seen in comparisons of figures between 1993 and 1997. Some of these improvements are that lead-time decreased from four weeks to six days, waste as a percentage of sales went from 3.8% down to 2.8%, inventory was reduced by almost 50%, sales increased by 50%, and customer satisfaction improved significantly.

Vendor City – A Distribution Partnership

Lewis J. Pratt, Senior Buyer
PPG Industries

Background

PPG Industries was founded in 1883 as a manufacturer of plate glass. The company later expanded into fiberglass and chemical industries. PPG had 80 facilities worldwide and revenues of $7.5 billion in 1990. At that time, the goal of the management was to grow in specific areas which they called "core-competencies," which, in this case, were specialty chemicals.

The PPG plant in Lake Charles, Louisiana manufactured chemicals such as barium chloride, chlorine and hydrocarbons. The plant had 640 acres of operating floor space with 1800 employees. In the beginning of the 1970's, the plant started to experience some major overseas competition especially from German chemical companies. The management had to lay off eight hundred people because they were not able to cut costs as much as the Germans did. In fact, the German companies were able to ship chlorine to Lake Charles all the way from Europe at lower cost. Thus it was obvious that the company needed a major change in order to reduce costs. To accomplish this, management decided to reengineer their processes.

Implementation

The first apparent factor that kept costs at a high level was the amount of inventory that the plant kept in its warehouse. The purchasing team found out that they had $18 million in inventory on average and approximately $5.5 million of that amount seemed to be redundant. For the most part, this cost was due to "not so significant" MRO (Maintenance, Repair and Operating Supplies) items that were bought using the same purchasing approach as used for purchasing other very critical material that their business needed.

The solution to this problem was to have suppliers bring material to PPG when it was needed rather than to have all the required material kept in PPG's warehouse. In the early 1970's, they started off by using computers in the warehouse, which made life much easier. Following that, the purchasing people agreed to reduce inventory costs through utilizing suppliers' warehouses. They called this approach the "Vendor Stocking Program (V.S.P.)."

First of all, the purchasing team had to make sure that senior management understood the significance of the program. Thus the team had senior management review its proposal in terms of aspects such as what the advantages were, the financial implications, how and by whom the project would be handled and how suppliers would be selected. With senior management support, the V.S.P. program was introduced. The basic advantages were reduction of MRO inventories, cuts in administrative costs caused by the deluge of invoices, reduction of procurement time, improvement in quality assurance through agreements with the suppliers using PPG quality

criteria in their facilities, and improvement of technical and material application support by the supplier. In addition to all of these changes, the program allowed the plant to improve its investment recovery program by finding alternative uses for waste with the assistance of suppliers.

As to supplier (vendor) selection, the company focused on the total cost of utilizing the vendor's product in the PPG plant rather than solely on the lowest possible price. The reason was that the cost of starting to utilize a product might far outweigh the savings achieved from purchasing it at a lower price.

The next step was to build "Vendor City" near the plant, for which Charles Miller Construction was selected as the project developer. The location would be the ten-acre tract located between Highway 90 and Interstate 10, which was approximately 600 yards north of PPG's main gate. Once the construction was completed, eleven vendors would be utilizing Vendor City as a warehouse for products that they were to deliver to the PPG plant. This strategy would incur no additional costs to PPG since the vendors would operate the warehouses.

The succeeding step was the implementation of an optimum process that would make the communication with the vendors efficient. The major component of the implementation program was that purchasing would act as the coordinator of all activities. An implementation team was developed which began to use EDP software for all purchasing related activities. Even the accounting and the payment system of the purchasing process would be handled electronically.

The total savings or cost improvement from the program was calculated as carrying cost plus the value of removable MRO inventory (which was the value of present inventory minus the value of special non-removable MRO inventory).

Results

Before the construction of Vendor City, the buyer would get on a PC and order the required material. The order would be printed out at the PPG warehouse. The material would be pulled off the shelf, loaded on a truck and shipped along with a flood of documentation to the station of the user. After Vendor City, the buyer orders materials through a PC. The order gets automatically printed out at a related vendor's warehouse. Materials are directly delivered to the user station without a deluge of paperwork. Finally, payment is made electronically.

In summary, the "Vendor Stocking Program" and "Vendor City" not only led to reductions in MRO inventory, but also to reductions in material and administrative costs by elimination of unnecessary paperwork, shortening of procurement time, waste reduction, quality assurance improvement, and technical support from the suppliers.