The workforce identifies and implements change to improve the quality of all processes at Laser Magnetic Storage International Company. Laser Magnetic Storage International Company (LMS) is a joint venture of N.V. Philips, of the Netherlands, and Control Data Corporation of Minneapolis, MN. The Tape Storage Division, located in Norristown, PA is a leading OEM (original equipment manufacturer) supplier of magnetic tape drives and holds a major market share of streaming GCR (group coded recording) drives.

When he arrived in 1983, Russ Kazda, president of the operation, quickly recognized the need for significant improvement. Problems included high operating costs, poor yields, poor workmanship, missed deliveries, and low morale. Half of all shipments occurred during the last week of every month.

Kazda challenged his management team to improve dramatically, particularly by reducing throughput times and safety stock. That challenge set in motion a process of continuous improvement through enforced problem solving that has brought tremendous results. They include 50 percent space reduction, 80 percent throughput time reduction, 90 percent overtime reduction, 60 percent output increase, 93 percent daily linear performance to schedule, 94 percent decrease in defects per unit, and 50 percent reduction in cost of quality.

A Process of Total Transformation
One of Russ Kazda’s favorite statements is, “If you’re not a lead dog, the scenery never changes. We like to see the scenery change.”

The strong top-down drive is balanced by a sense of humor, genuine joy of team accomplishment, delegation of authority to line employees, and participation at all levels. Judging by the smiles and enthusiasm observed during the plant tour, being an LMS employee today is a satisfying experience.

Quality is described as the skillful and effective use of resources to effect continuous improvement.

The foundation for the continuous improvement drive at LMS is application of the Total Quality Management Process (TQMP). The workforce has responsibility for identifying and implementing change to improve the quality of all processes. Quality is described as the skillful and effective use of resources to effect continuous improvement. It is not a program, but a method of operating. It is not like putting on a piece of clothing; rather, it is a total transformation of the company’s “body.” Real physical, mental, emotional, and attitude changes have taken place at LMS. The company now looks different, people think and feel differently, and their fundamental attitude has changed greatly since 1985. Most importantly, they behave differently; the company culture has been transformed.

The first major step in the process was to recognize the need for change and improvement. Poor performance and an increasingly competitive environment made the need for change crystal clear. The next major step was to change and improve. The third major step, still under way, is maintaining an awareness of the need for continuous improvement. After the first and second layers of the most obvious “rocks” (problems) in the manufacturing “stream” are removed, it becomes a serious challenge to continue improvement by attacking tough, smaller “rocks.” Evidence from the presentations and plant tour showed that LMS is meeting this challenge.

TQMP has shifted attention from correction to prevention, from front-end costs to life cycle costs, from well-documented deviations to no deviations, and from an “acceptable quality level” mentality to one of continuous improvement. Quality is now everyone’s responsibility. Manufacturing goals are based on customer requirements rather than negotiations between LMS departments.

Cross Functional/Multi-Level JIT Teams
In 1985, key manufacturing managers began an intense study of Just-In-Time (JIT). The study included plant visits, seminars, and reading key texts, such as books by Schonberger and Hall. Top management was dead serious about the reading; book reports were demanded.

Within a short period, a pilot was chosen and a JIT line was im-
implemented in the key product area, the Keystone Tape Drive. The pilot ran for two months. Every week, throughput time and yields showed significant improvement. Gradually, the key people became convinced that continuous improvement was possible through focused problem solving. As the layout was changed and inventory lowered, problems became exposed and demanded improvement action. Based on this pilot experience, the theme for further change was named Continuous Improvement Through Enforced Problem Solving.

Awareness grew that the company was a whole system, and that four pillars were needed to create an integrated, “fast cycle” company. The four pillars are Just-In-Time (JIT), Computer Integrated Manufacturing (CIM), Total Employee Involvement (TEI), and Total Quality Control (TQC). These four pillars all need to be dealt with, regardless of where initial efforts begin.

In the initial stages, there was considerable doubt and resistance. People doubted that the new approach would have lasting top management support. To overcome this doubt, a full-time “champion,” Len Engel, was selected. Gradually, through careful communication, the doubt and resistance issues were resolved. Managers either bought into the new way or they were eased out. What remained was a highly-motivated, unified management team.

In becoming a more unified team, the management group became more aware of how the pyramid organization structure resulted in divisions, lack of clarity, and distrust—the “functional silo syndrome” (Target, Summer 1988). As a remedy, they implemented a system of cross-functional, multi-level teams to solve problems and to install JIT lines. They also formed a number of MRP (Material Requirements Planning) teams. These teams implemented a new MRP system in five months. The “problem mentality” of the past, resulting in endless lists of problems never resolved, was permanently discarded. Now, the focus is always on the future, on eliminating bottlenecks, delays, errors, and inventories.

An excellent feature of the cross-functional, multi-level team approach is that monthly continuous improvement meetings are held with upper management. In these meetings, everyone (including engineers and support people), presents results of improvement activities and receives recognition for efforts and successes. Another function of these monthly meetings is top management involvement in removing obstacles to improvement.

Improvements Everywhere

As the cells were implemented throughout the plant, people on the line were given the authority to shut the line down (trouble lights) to correct problems. Labor efficiencies were no longer tracked. In time, ownership of the process was turned over to the cell employees themselves.

The main measure of success in implementing the team approach was manufacturing throughput time. The overall 80 percent reduction resulted from the various teams aggressively attacking various pieces of the process. These team-generated solutions included everything from major changes in vendor delivery procedures to new ways of organizing and labeling materials on the line. For example, on the tape deck subassembly line, much lifting of the unit had been required.

The main measure of success in implementing the team approach was manufacturing throughput time.

Today, the product is built horizontally, fitting into a molded module that moves on a flexible rolling conveyer.

The schedule is now fixed each day to support a linear production schedule. Whenever the schedule is met—even if it’s only 2 p.m., production stops and the rest of the day

Fig. 1. Keystone Assembly workcell meeting in progress, from left, Reggie Williams, Sally Atkins, Helen Winnies, Phyllis Grady, and Dave Clark.
is spent on work cell meetings and implementation of new ideas. The cell members, with necessary support, help solve all cell related problems. (For improvement ideas beyond the cell, a traditional suggestion system is used.)

In the main product area, the Keystone Mixed Model line, one senior assembler, Penny Comtois, enthusiastically described the Kanban system providing the line with a particular door three times a day. "Before JIT," she said, "we had doors stacked up everywhere — just-in-case. We just kept building them. Unfortunately, when we needed a specific door for an order, we didn’t have the necessary parts for that type because all the parts were on other doors of a different type. That never happens now. We have just what we need when we need it."

The Kanban system, used in conjunction with bar coding (for recording purposes), is simple. When one of the two boxes of a particular part on the line is empty, the operator signals that it needs to be filled while the second box is being used up. The system functions very smoothly.

Many non-value adding steps have been eliminated. Inspections, subassembly stocking, and batch issues were cut out. Some subassemblies were incorporated into final assembly; others were subcontracted.

In the past, final assembly was always behind schedule. To improve, the supplier team determined the exact quantity needed of each part in the final assembly process. Then, negotiations with vendors took place to ship that quantity in a box. This process resulted in an effective pre-defined vendor pack system. The team also implemented a new vendor certification system, emphasizing process capability — (quality, on-time delivery) — as the major criterion. Through these efforts, and by single-sourcing as much as possible, the number of suppliers was reduced by 50 percent. Seventy-five percent of vendors are now certified.

Another innovative improvement implemented by the supplier team was the controlled delivery routes system. Arrangements were made with suppliers to deliver in small quantities weekly. Four trucks now follow a set route every week and pick up from a number of suppliers along that route. Forty-five key suppliers participate. This process represents 70 percent of the Keystone material, according to Materials Manager Jim Mellon.

In the warehouse stock-to-final assembly area, a material specialist, Israel Avramovitz, described how the work cell team chose a new hand-held reader for the bar-coding system. Vendors came in and showed the team a variety of models after the team had made a case that the reader would help accuracy. They chose a model based on lightness and flexibility. It can be used by both left-handed and right-handed people — another example of the benefits of giving more control where the practical work expertise exists.

According to Avramovitz, the warehouse used to be “wall to wall parts.” Now, parts stocks are greatly reduced. The goal is to eventually eliminate the warehouse altogether, except for a small receiving area.

Through the efforts of the supplier team and the warehouse cell teams, clock-to-stock cycle time has been reduced from 60 hours to six hours; stock-to-final assembly cycle time has been reduced from 10 days to two hours. Issue yield went from 65 percent in 1984 to 99 percent in 1989 and cycle count accuracy improved from 60 percent to 92 percent while total inventory was reduced by 70 percent.

Total Employee Involvement (TEI)

In the early stages of implementation, teams were strictly cross-functional, dominated by management and engineering people. As the continuous improvement process unfolded, it became increasingly clear that every employee needed to get involved. According to Manufacturing Manager John Purtell, three
1. Increased competitive pressure created the need to reallocate engineering resources to new products from existing products.
2. Increased exposure to TEI concepts through seminars and workshops.
3. Actual results from work areas having the greatest amount of employee involvement showed the power of utilizing this great resource.

Of these three factors, the third—evidenced through personal experience—was the most significant motivator. One example of that evidence came from a team that was formed on the Sentinel product line (a 1/4-in. cartridge tape drive). The product was well past the midpoint of product life two years ago when LMS decided to convert it to a pull JIT line. There were no engineering or production control resources to make this change. Still, the line manager and work cell employees agreed to try. On their own, they reconfigured and balanced the line, established Kanban sizes, and improved and documented end-of-line quality procedures. The results were stunning—50 percent reduction in floor space and 75 percent reduction in WIP (work in process). In 1988, Sentinel achieved a 100 percent linear production to daily schedule for the entire year while achieving six straight months of defect-free quality.

Work cell teams of 8–10 people now function in all areas of the plant, including the warehouse. Production operators, warehouse personnel, and electrical technicians function as work cells wherever possible. The teams meet at least twice a week for group problem-solving sessions, which are held exclusively to discuss and resolve production problems. Members take turns facilitating these meetings. Some examples of work cell activities include:

### Assisting the cell teams are support teams composed of cross-functional members from test engineering, manufacturing engineering, production control, supplier quality, etc.

Assisting the cell teams are support teams composed of cross-functional members from test engineering, manufacturing engineering, production control, supplier quality, etc. When a yellow or red light occurs on the line, support team members summoned via beepers help solve the problem to keep the line moving—much like a team of paramedics at an accident. (A yellow light indicates a line in danger of shutting down; a red light signals that a line is down.)

The support team is responsible for coming up with a temporary solution to keep the line moving. The team is also responsible for developing a permanent solution within 30 days. All yellow and red light events are reviewed weekly in team meetings. If necessary, events are escalated to levels beyond the support team (that is, design, upper management, etc.).

The work cells rotate jobs (usually daily) in the non-union shop. Pay grades have been reduced from eight to three (from five to two operator grades; from three to one electrical technician grade). A pay for performance plan pays and promotes people according to their skills and their performance according to set criteria: quality, work cell participation, attendance, and safety. Seniority is no longer the primary criterion.

In order to cross-train all cell members, an outstanding designated trainer program was developed. In each cell, a person is chosen—based on interpersonal and technical skills—to train cell members to perform the various operations within the cell. Training is a part-time assignment for the trainer, usually taking up about 10 percent of the person's time. This system works well because it is in-depth peer coaching, another example of the benefits of turning ownership over to the cell members.

### Opportunities for Further Improvement

Nearly every element of JIT, TOC, CIM, and TEI can be seen in some area of the Tape Storage Division of LMS. The division has come a long way on the road to world class manufacturing in a few years. The strengths of the current operation noted by one of the discussion/feedback groups were:

- Depth of management commitment and involvement
- Roles and philosophy well understood
- Cross training and designated trainer program
- Work areas clean and well-organized
- Excellent quality and reliability programs
- Support team level of participation and short/long term solutions
- Employee event recognition
- Manufacturing effectiveness as a marketing tool
- TEI is real
- Leadtimes well-managed
- Early manufacturing involvement in new product introduction

The more that is done, the more one can see to do, however, and the workshop discussion teams identified opportunities for further improvement. The main opportunity was to aggressively improve design...
engineering to reduce new product introduction time. This opportunity was already well recognized by LMS management. Another possibility is to eliminate burn-in of assemblies — to have vendors "pre-burn." A third opportunity is further reducing or eliminating the warehouse by re-locating more stock at point of use. Further improvements could also be made in plant layout, and a market study might identify new products (to fill available plant space). Finally, more formal group problem solving and facilitator training would bring the TEI efforts to a still higher level of effectiveness.

Judging by the division's performance to date and by management's commitment to continuous improvement, there is little doubt that these opportunities will be pursued aggressively.

Fig. 3. Cleanliness and organization are reflected in the Keystone Deck Assembly Line. A red or yellow strobe light is at each station.

Author:
Per Johansen is a Coopers & Lybrand supervisory consultant in the firm's Just-In-Time practice, Boston, MA.