IMPLEMENTING LEAN MANUFACTURING

Analyze each step in the original process before making a change.

Lean manufacturing's focus is on cost reduction and eliminating activities that do not add value to the manufacturing process. Basically, what lean manufacturing does is help companies to achieve their targeted production rates by introducing tools and techniques that are easy to apply and maintain. These tools and techniques reduce and eliminate waste, which is anything that is not needed in the manufacturing process.

For example, manufacturing engineers set out to use the six-sigma DMAIC (Design, Measure, Analyze, Improve, Control) methodology in conjunction with lean manufacturing to meet customer requirements related to the production of tubes. Manufacturing engineers were charged with designing a new process layout of the tube production line. The objectives for project were:

* Improved quality
* Decreased scrap
* Delivery to the point of use
* Smaller lot sizes
* Implementation of a pull system
* Better feedback
* Increased production
* Individual Responsibility
* Decreased WIP
* Dine flexibility

Before making changes, the team analyzed each step in the original layout of the tube production line process, and aimed to:

1. Try to understand the original state process, identify the problem area, any unnecessary steps, and any "non-value added".
2. After mapping the process, the lean team collected data from the Material Review Board (MRB) bench to measure and analyze major types of defects. To better understand the process, the team also did a time study for 20 days on a production run.

In the original state, the tube line consisted of one operator and four operations, separated into two stations by a large table using a push system. The table acted as a separator between the second and third operation.

The first problem that the team discovered was that the line was unbalanced. The first station was used about 70% of the time. Operators at the second station were spending a lot of their time waiting between cycle times. By combining stations one and two, room for improvement became evident with respect to individual responsibility, control of inventory by the operator, and immediate feedback when a problem occurred. The time study and the department layout reflect these findings.

They also recognized a second problem. Because of the process flow, the production rate did not allow the production schedule to be met with two stations. Because operators lost track of machine cycles, machines were waiting for operator attention. Operators also tried to push parts through the first station (the bottleneck operation in the process) and then continued to manufacture the parts at the last two operations. Typically, long runs of in-progress items built up, and quality problems were not caught until a lot of defective pieces were produced.

The original state data was taken from the last 20 days before the change. The teams analyzed each step in the original and made changes. The time study on the original process was used as the basis for reducing cycle time, balancing the line, and re-designing the line using Just-In-Time kanbans and scheduling. This was aimed at improving quality, decreasing lot size and in-progress items, and improving flow. New process data was taken starting one month after implementation. This delay gave the machine operators an opportunity to train and get to with the new process layout system.

With a U-shaped cell design instead of the two-table system, the new parts met the team's needs. The table in the original process was removed, which almost eliminated the backlog in in-progress items. With this reduction in in-progress items, production increased.

Some of the concepts used to improve the process included total employee involvement (TEI), smaller lot sizes, scheduling, point of use inventory, and improved layout. All employees and supervisors in the department were involved in all phases of the project. Their ideas and suggestions were incorporated in the planning and implementation process to gain wider acceptance of the changes to the process. Smaller lot sizes were introduced to minimize the number of parts produced before defects were detected. Kanbans were introduced (in the form of material handling racks) to control in-progress items and to implement a pull system. And the cell layout decreased travel between operations. Operators were authorized to stop the line when problems arose. In the original design, the operators continued running parts when a operation was down. With kanban control, the new layout eliminated the ability to store in-progress items, requiring the operator to shut down the entire line. The cell layout provided excellent opportunities for improving communication between operators about problems and adjustments that led to better quality.

Day-to-day inspection of the original-state process showed that operators spent a lot of time either waiting for someone to handle materials, or acting as material handlers themselves. With U-shaped cells, delivery to the point of use allowed the operators to be much more efficient. The operator placed boxes of raw material on six movable roller carts, which made them easy to access. These six boxes were enough to last for 24 hours. To reduce setup times, tools needed for machine repair and adjustments were located in the cell. The screws were not standardized, and tools were set up in order of increasing size. This allowed workers to quickly identify the proper tool.

The process was monitored for three months to verify that it was sustainable. Comparing time studies from the original-state with the new layout demonstrated an increase in production from 300 to 514 finished products per shift. The new layout eliminated double handling between the second and third operations, as well as at the packing step. It also reduced throughput time by making it easier to cycle all four operations in a pull-system order. Customer demand was met by two shifts, which reduced the labor cost.

The results of the redesign are as follows:

* In-progress items decreased by 97%
* Production increased 72%
* Scrap was reduced by 43%
* Machine utilization increased by 50%
* Labor utilization increased by 25%
* Labor costs were reduced by 33%
* Sigma level increased from 2.6 to 2.8

This project yielded reduced labor and scrap costs, and allowed the organization to do a better job of making deliveries on time, while allowing a smaller finished-goods inventory. Daily production numbers and single-part cycle time served as a benchmark for monitoring progress towards the goal. This led to a sigma level increase, 43% reduction in defects, 97% reduction in in-progress items, and a production increase of 72%.

Implementing lean is a never-ending process: it is continuous improvement, after all. When you get one aspect of lean implemented, it can always be improved. Don't get hung up on it, but don't let things slip back to the starting point. There will always be time to go back and refine some of the processes.

Before Lean Manufacturing was implemented at this plant, it operated using traditional manufacturing. Traditional manufacturing consists of producing all of a given product for the marketplace so as to never let the equipment idle. These goods then need to be warehoused or shipped out to a customer who may not be ready for them. If more is produced than can be sold, the products will be sold at a deep discount (often a loss) or simply scrapped. This can add up to an enormous amount of waste. After implementing Lean Manufacturing concepts, the company started to use just-in-time. Just-in-time refers to producing and delivering a good in the amount required when the customer requires it and not before. In lean manufacturing, the manufacturer only produces what the customer wants, when they want it. This often a much more cost-effective way of manufacturing when compared to high-price, high-volume equipment.

Knowledge Check:

1. What is 5S?
2. Explain each "S" of the 5S.
3. Explain the Kaizen concept.
4. What is pull processing?
5. What is poka-yoke?
6. What is six-sigma DMAIC?
7. What are the objectives for a new process layout of the tube production line described above?
8. Before making changes, what do the team of manufacturing engineers do first?
9. List the results of the redesign.
10. What is the key to implementing a Lean new idea or concept?

Source: Adapted from LamNgeun Virasak; <https://openoregon.pressbooks.pub/manufacturingprocesses45/chapter/chapter-7-lean-manufacturing/>