Journal of Engineering and Applied Sciences 1 (4): 500-503, 2006

PLean Manufacturing and the Automotive Component Supply Industry

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Abstract: This study deals with the development of a framework for the implementation of lean manufacturing principles in the automotive component supply industry. This study consists of five major steps that involve extensive teamwork through a continuous improvement platform. The developed continuous improvement model was successfully applied during a kaizen event at the HVAC assembly cell of a leading automotive component supplier.

Key words: Lean manufacturing, continuous improvements, automotive industry, kaisen event

INTRODUCTION

The 1990's introduced a new age in American manufacturing. Global competitiveness among manufacturing industries reached a new level. The new slogan in the manufacturing arena became doing more with less. Companies started increasing productivity through both job elimination and equipment investment. Companies focusing on equipment investment and leaner payrolls increased their probability for future improvement in productivity growth[1].

The automotive industry played a key role during this manufacturing revolution. The end of the 1970's had represented a time for discovering the advantages of Japanese auto production, especially the Toyota Production System. A large productivity gap between Japanese automakers using lean production techniques and American and European automakers utilizing traditional mass production was evident. The Japanese auto parts suppliers focussed on producing quality products at lower costs; for instance new product development time for the Japanese averaged only 46 months while in the U.S. it averaged 60 months[2].

Lean manufacturing involves the flowing of a product through a process over a minimal time by the elimination of waste and continuous improvement. Toyota discovered this production philosophy through manufacturing techniques in hope for survival. They were running out of space, their huge inventories were consuming the company's cash flow, vertical integration of all their parts businesses was not affordable and a shrinking automotive market was pressing for a larger variety of vehicles[3].

The introduction of lean manufacturing in America was no less dramatic. After suffering enormous losses, General Motors, Chrysler and Ford started turning their attention to the Toyota Production System. Through joint ventures with Japanese companies such as Toyota, Honda and Mitsubishi, these American automakers greatly boosted their productivity and thus profitability, during the late 1980's and early 1990's[4].

The cultural change that these companies experienced in their production systems is being gradually embraced by their component suppliers. This presses manufacturers to devise versatile and effective implementation programs to ease the production and organizational disruptions originated from newly adopted lean manufacturing techniques.

THE LEAN MANUFACTURING PRINCIPLES

Lean manufacturing is characterized by five essential principles:

- Specify value in the eyes of the customer,
- Identify value stream and eliminate waste,
- Make value flow at pull of the customer,
- Involve and empower employees,
- Continuously improve in pursuit of perfection.

Specifying value in the eyes of the customer involves identifying the desired product, quality level, delivery rate, response time expectations and price demanded by the customer. The second principle entails aligning resources strategically to eliminate seven types of waste commonly know as COMMWIP, i.e., Correction, Overproduction, Material movement, Motion, Waiting, Inventory and Processing[5]. Non-value activities are those utilizing resources time but not contributing to customer requirements. Value

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added activities fabricate material or information fulfilling customer demands.

The third principle is making value flow at the pull of the customer. To accomplish this task, the production line supplying the customer is flexible to the pull of the customer. If the customer demands x units today and y units tomorrow, the manufacturing system must be capable of producing at variable rates.

The final two principles are the cornerstones of lean manufacturing. In the pursuit of lean, employees are the key to success. Employee involvement in the change process allows implementation to proceed at a much more rapid rate[5]. Suggestion programs provide insight from employees working everyday on the floor providing input on how things could be improved. Continuous improvement is an everyday process in the acquisition of manufacturing excellence.

IMPLEMENTING LEAN IN AMERICAN AUTOMOTIVE COMPONENT SUPPLIERS

Delphi saginaw steering systems: In the early 1990's, Delphi Saginaw Steering Systems (DSSS) in Saginaw, Michigan, signified the typical American plant on the verge of bankruptcy. The plant was operating completely in the red[6]. In 1993, with the incorporation of a new plant manager, the DSSS started implementing the concepts of cellular and synchronous manufacturing. WIP inventory was significantly reduced and a continuous improvement plan was devised for the employees[7].

The transformation process into lean production was then centered around a five-year plan on material flow. A pareto analysis was conducted to determine the largest cost savings and order of implementation of improvements. Workplace organization was redesigned through the five-S's principle: Short, Straighten, Sanitize, Sweep and Sustain[7].

The implementation of lean manufacturing resulted in many measurable improvements at DSSS. Employee participation in continuous improvement efforts increased approximately 50%. The number of rejected parts per million from the customer was reduced from 1917 in 1993 to 75 in 1997. Moreover, annual productivity increases were experienced during those years[7].

Freudenberg-Nok: Freudenberg-Nok, a constituent of NOK Group Companies, is the world's largest manufacturer of automotive sealing components. In 1992, Freudernberg-Nok embarked on the implementation of their lean production system called GROWTTH. GROWTTH focuses on employee teamwork and communication in an effort to eliminate inefficiencies in the use of time, labor, materials and space[8].

This sealant supplier committed to establishing new standards for quality, cost and delivery by diminishing waste within the organization. Freudenber-Nok started the GROWTTH program by obtaining the buy-in from management and shop floor employees. The management teams devoted 30% of their workweek for lean training over one year. Training involved participating in kaizen events as teams.

The next step in the GROWTTH program implied communication to the people on the floor. The management team devised the strategy of banishing the floor employee view that lean meant eliminating jobs. They made the floor employees realize that lean systems create opportunities for increased business while enhancing job opportunities[9].

Through lean implementation, GROWTTH created one-piece flow, reduced setups and tool changes, freed floor space, maximized product/process value and standardized processes. The results of becoming lean for Freudenberg-Nok were impresive. Over four years, Fredenberg-Nok performed 2,500 kaizen projects in 15 manufacturing plants. Each project was audited and the results showed an average variable cost saving of $40,000 (3.2% of sales and 18-25% of controllable variable costs). Workers compensations and OSHA-reportable accidents were reduced by 50%. In addition, productivity and value added activities doubled[8].

Donnelly corporation: As the world's largest manufacturer of automobile exterior mirrors, Donnelly Corporation, turned to lean manufacturing to improve quality and delivery. In 1995, Honda, one of Donnelly's customers, threatened the company with losing their business because of quality issues and late shipments[10].

At the Grand Haven plant, which supplies Honda's exterior side view mirrors, the paint booth represented a major bottleneck. In 1991, Donnelly agreed with Honda to purchase a new paint system. By fulfilling Honda's request, Honda awarded additional business to Donnelly. Although sales increased tremendously at the Grand Haven plant by 1994, so did the level of chaos. Management then attempted a program called Delta, which combined General Motor's synchronous manufacturing and Honda's Best Practice Program; unfortunately, Delta was unsuccessful in resolving Donnelly's problems[10].

Finally, Donnelly decided to conduct kaizen events in the plant. Utilizing kaizen events was a quick method in determining answers to production issues. A total of 29 kaizen events, lasting four days, were conducted on setup reduction, paint yield, one-piece flow and others[10].

Setup reduction events concentrated on the plant's injection molding process. The setup times were reduced from 2 h to 20 min. The kaizen events in pant yield were also successful. First time through quality improved from 5,300 ppm to 3,600 ppm. In addition, the production flow was revised to create one-piece flow. U-shaped cells replaced single workstations and they were designed based on a synchronized production pace.

The kaizen events proved very successful for Donnelly. WIP inventory was decreased from 5.6 to 4.1 days, a 25% improvement. Productivity increased nearly 18%. Sales per employee experienced a 50% increase from $140,000 in 1994 to $217,800 in 1995[10] .

A FRAMEWORK FOR LEAN MANUFACTURING IMPLEMENTATION

The implementation of lean principles engages several resources working together to create change of the shop floor in a timely manner. The main goal of the designed framework was to implement at least 80% of the continuous improvement changes during a five-day workshop, referred to as kaizen event. The developed implementation methodology involved five major steps:

- Identify
- Analyze
- Plan
- Implement
- Evaluate

The identify stage involves nearly 4 days of tasks to be completed 15 to 20 days prior to the implementation event. The first task implies understanding the business goals by devising goal and policy deployment. A prioritization matrix is then generated based on the urgency of change of various areas within the organization. Next, the focus of the continuous improvement workshop must be decided according to the prioritization matrix results. The third task defines the overall purpose and initial targets for the continuous improvement workshop. These targets are normally originated from business needs and benchmarking. Then, team members for the workshop m ust be identified. The members normally consist of representative from the direct area of the workshop, resources outside the area and continuous improvement team. Finally, once the workshop's scope has been defined, the SMART goals of the event are agreed upon. SMART is a description of actionable goals that are Specific, Measurable, Attainable, Relevant, Tractable and Timebound.

Analysis of the current state constitutes the second step in the change process model. This step should take between 5 to 15 days to be completed. It needs to be performed two weeks prior the continuous improvement workshop event. The analysis consists of defining the set of data needed for the workshop as well as recollecting it. This normally entitles conducting a time study analysis, recording current inventory levels, developing a current layout, determining the first time through quality and productivity and defining the profitability (or lack of it) status of the production system under analysis. A comprehensive list of training needs for each involved resource constitutes the ultimate goal of analysis phase.

The planning step has to be carried out 10 days prior to the kaizen event and it normally takes between 5 to 15 days for its completion. Planning for the kaizen event is important since time constraints may delimit the activities and scope of the workshop. During this step, the management team must identify and agree on the targets for the continuous improvement event. The workshop's agenda is then established and briefed to each participant for his/her approval. Once the agenda is approved, individuals are trained on lean manufacturing and continuous improvement principles. The required workshop resources are then aligned and committed to the event. Finally, all collected information on the manufacturing process, to be scrutinized during the kaizen event, is verified and validated.

The implementation step is the actual five-day kaizen event. The first day of the workshop begins with communication and training among the groups. The previously collected and analyzed data is then reviewed and the initial state defined. During the second day, the final implementation plan is formalized and all resources are given assigned tasks. The next two days are devoted to the actual implementation of the plan. The fifth and final day involves summarizing the activities performed in the workshop, calculating the obtained and projected, improvements, writing a 30-day follow-up checklist and communicating the results to the management and the companies' union officials.

After the five-day event is over, all results are verified. Verification of results involves the comparison of productivity, inventory and floor space savings generated by the improvements implemented in the workshop. In addition, every item on the 30-day follow-up sheet is evaluated and target dates for corrective actions are selected. At the end of the 30-day follow-up, the results are reviewed again. Besides this thirty-day review, the overall results of the improvement plan over a period of six months are evaluated through conventional measuring techniques in productivity, quality, floor space requirements and inventory levels.

Continuous improvement model implementation: In June 1999, the described kaizen framework was implemented in the Heating, Ventilation and Air Conditioning (HVAC) assembly cell of a world's leading automotive component supplier's plant located in the Southeast of the United States. The performed kaizen event involved an exhaustive analysis of the current state of the facility as well as a comprehensive review of operational availability, throughput efficiency, inventory levels, floor space usage and ergonomic-related issues of the HVAC assembly cell. A time study analysis was performed to develop standard times for all work elements involved it the assembly line, as well as to obtain relevant insights about the balance status of the line.

Three line balance alternatives were generated during the planning phase of the study. Criteria on floor space savings, productivity improvement, operator utilization, line efficiency, inventory savings and operator preferences were used to screen those alternative and select the most promising one.

During the five-day kaizen event, the new selected line balance was completed. A 30-day follow-up was then conducted where performance measures on productivity, quality, floor space requirements and inventory levels were assessed. A six-month evaluating period followed to corroborate that the obtained improvements sustained through time.

Among the benefits received from conducting the kaizen in the HVAC assembly cell were a 30% reduction in utilized floor space, an improvement in the presentation of parts through re-designed carts - which led to a reduction in nonproductive time-, a 50% reduction in line-side components inventory and a more efficient tools arrangement-which implied an increase in equipment utilization.

CONCLUSION

This study discussed the implementation of lean manufacturing principles to the automotive component supply industry. A continuous improvement model consisting of five major steps was presented. This implementation study involves extensive teamwork through a continuous improvement platform that wraps up in a five-day kaizen event. The discussed methodology was successfully applied at the HVAC assembly cell of a world's leading automotive component supplier, where a 30% reduction in floor space usage and a 50% decrease in line-side components inventory was attained.

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