Abstract

The philosophy of lean manufacturing originated at the Toyota Motor Corporation has been implemented successfully in both the manufacturing and service sector. In this case study, we describe how Seaver Finishing, a family-owned electrodeposition facility in Grand Haven, Michigan, USA, has made some positive strides in their lean implementation, after encountering earlier unsuccessful implementation in 2007. This case study is valuable to Indian manufacturing organizations that are in the process of implementing the lean philosophy or are struggling with their lean implementation.

Keywords: Application, case study, lean, manufacturing.

Introduction

Lean manufacturing is a method of improving the efficiency of a process or an entire company by reducing or eliminating various types of waste. As the name “lean” implies, it involves cutting the excess. This waste or excess can be in the form of material scrap or rework, excess inventory, overproduction, unnecessary movement of product or employees, waiting, and time or money that did not add value to the final product or service that the customer receives. In other words, lean manufacturing is having the “right items of the right quality and quantity in the right place and at the right time” – nothing more or less.11

The philosophy of lean manufacturing originated at the Toyota Motor Corporation in Japan after World War II but has since been applied successfully at companies around the globe. Ultimately, lean manufacturing improves quality at every step of a process, striving towards zero-defects and results in cost savings and improvements in operational, financial, and environmental performance10 while it has traditionally been implemented at manufacturing plants, service companies such as hospitals, hotels and restaurants have also benefited from reducing waste and improving quality. By means of a case study, this study looks at the application of lean concepts at Seaver Finishing, an electrocoating facility located in Grand Haven, Michigan, USA. The study also provides specific recommendations that the management of Seaver Finishing can focus on improving as they continue their lean journey.

Lean Manufacturing and Six Sigma

Lean manufacturing is a customer-focused, working philosophy, sometimes called “TQM on steroids”. While it has evolved and gone by various names throughout the past century, lean manufacturing generally consists of four different segments: just-in-time (JIT), total quality management (TQM), total preventative maintenance, and human resource management.11 Despite their different areas of focus, these segments all share the same goal of eliminating waste and error, and continuously improving. Additionally, within lean manufacturing there is also a scientific methodology for lessening defects known as Six Sigma.

Six Sigma is defined as “an organized and systematic method for improvement of processes and the development of new products and services, based on statistics and scientific techniques, with the purpose of reducing defects defined by the customer”.6 Six Sigma also involves decreasing defects by “reducing the variability in the processes,” defined by Motorola, one of the first developers of Six Sigma, as having 3.4 defects or less per million parts.6

The underlying goal of all these branches of lean manufacturing is to reduce costs and increase profitability. Specific areas of manufacturing when improved using lean can yield increases in profit are set-up times, quality, inventory, cycle time, and productivity. One way a company can use cycle time and productivity to increase profit is by identifying the bottlenecks within their processes, or the steps of a process that take the most time, and then increasing the capacity of those bottlenecks. Bottlenecks are often signaled by a pile up of work-in-process inventory in front of a particular station, machine or area, because the steps before it moves are more quickly than the bottleneck can.

Once the bottleneck is identified, to maximize its capacity, the company must ensure that the bottleneck’s time is not wasted. A bottleneck’s time can be wasted when it is sitting idle, during an employee break or shift change for example, when it is processing parts that are already defective or that should have been removed previously by quality control, and lastly when the bottleneck is made to process spare parts, or parts that are not currently in demand. By eliminating these types of waste at the bottleneck, its capacity will increase, thus reducing cycle time and increasing productivity, and ultimately increasing profitability.2

In order to measure the effectiveness and results of lean manufacturing and Six Sigma implementation, it is important that a company uses specific financial metrics as well as customer satisfaction metrics. A common lean method of measurement is known as the DMAIC method which stands for Define, Measure, Analyze, Improve,
Control, and improves the efficiency of processes using data.\textsuperscript{5} Other tools used for analysis include cause-and-effect diagrams, control charts and pareto charts.\textsuperscript{6}

**Lean Manufacturing as an Organizational Culture**

In order for lean manufacturing to be implemented successfully, it must either align with the existing organizational culture at a company, or management and associates must be willing to put forth the effort to change the culture so that it becomes an environment in which lean practices can succeed. According to Irving Wladawsky-Berger,\textsuperscript{8} “when it comes to a company’s ability to formulate and execute upon a transformational strategy, few factors, if any, are more influential than its culture”. This is because lean manufacturing is more than just implementing a few new rules at a company – it involves ingraining lean practices into the daily routine and norms of a company, or even initiating a complete cultural change within the company. Marzagao and Carvalho\textsuperscript{9} even note that “Six Sigma should be studied under the aspect of cultural change”.

In other words, lean manufacturing and six sigma’ implementation involve changing collective beliefs, attitudes and customs of a company. It is likely that manufacturing implementation would fail at a company where their cultural norms consist of quality checks that are not taken seriously and defective parts that are still given the “OK” to ship out to customers. Instead, they would need to formulate a culture where thorough quality checks are expected and there is zero-tolerance for defective parts. Bortolotti et al\textsuperscript{10} also add that “a hierarchal culture based on control, formalization, stability and predictable outcomes is positively related with process quality improvements but not with innovation, while vice versa a developmental culture characterized by flexibility, growth, innovation and creativity is correlated with innovation but not with quality”.

One way to achieve an organizational culture in which lean practices would thrive is to communicate to employees the potential benefits of their efficiency, attention to detail and reduction of waste. For example, Southwest Airlines successfully created such a culture by creating a stock-ownership plan for employees so that employees could more clearly see the effects of their lean practices on the bottom line.\textsuperscript{7} Additionally, former CEO of Southwest Airlines Herb Kelleher transmitted an organizational culture of care, friendliness and personability which helped make employees loyal to whatever vision he had.

As a result, “flight attendants would work together to clean planes and get them back in the air within twenty-five minutes… pilots have been known to work with ramp agents to get bags unloaded. Even though everyone works extremely hard, they feel encouraged to find new ways to cut costs and improve operations”.\textsuperscript{11} None of this would have been possible without Southwest Airline’s existing organizational culture – employees “feel encouraged” because their culture positively reinforces and inspires such lean behavior. Therefore, it is clear that organizational culture is directly linked to the success or failure of lean manufacturing initiatives.

A key component of a company’s organizational culture that is a critical success factor for lean manufacturing implementation, and as exemplified by former Southwest Airlines CEO Herb Kelleher, is strong leadership. Leaders have the strongest influence on a company’s culture, and therefore must exercise “rigor in execution,” or, in other words, they must be committed, consistent and enthusiastic throughout the process.\textsuperscript{5} Leaders are responsible for communicating the vision to the rest of company, and, to be most effective, must exemplify the desired outcomes and empower others to be leaders. Even more than being role models of the desired culture, leaders should also be responsible for communicating to employees the reasoning behind the new vision and system.

According to Naslund\textsuperscript{6}, “Education in a systems and process view of organizations answers the questions why the change of the system is needed, how it is supposed to change, and what the benefits will be to the system”. Educating employees about the reasons and benefits of lean will further encourage them to get behind the leaders. Additionally, Naslund\textsuperscript{6} says that “Successful implementation of any change effort most likely requires that they implemented with a systematic, holistic understanding of organizations”. Once again, it is leadership’s responsibility to communicate the lean vision to the company, and to model the desired behavior. Both play a critical role in the success or failure of lean implementation.

**Lean Manufacturing and Environmental Management, “Lean is Green”:** Recently, especially with the Millennial generation occupying the workforce and the consumer market, there has been a sociocultural trend towards a preference for environmentally-friendly and sustainable companies, prompting researchers to study possible connections between lean manufacturing and environmental management, and the effect lean manufacturing has on sustainability. Because this research is so new, findings have been largely inconclusive. According to Henao et al\textsuperscript{13}, “current [lean manufacturing] research still falls short of proper identification, proof, and more importantly, management of the issues regarding its impact on long-term sustainability”.

However, more often than not, lean manufacturing and environmental management have shown to be complementary rather than trade-offs. According to Yang et al\textsuperscript{10} lean manufacturing and environmental management practices “are synergetic in terms of their focus on reducing waste and inefficiency”. While lean manufacturing can have an adverse impact on the environment in terms of increased emissions resulting from increased delivery frequencies...
caused by just-in-time inventory (the Toyota Production System was linked to worsening air pollution in Tokyo in the 1980s), the positive impacts, such as reduced waste, reduced energy usage and consumption of fewer resources, seem to be greater.

Also, total quality management and 5S, which reduce defects and improve workplace organization and efficiency, have been shown to improve quality, safety and availability of equipment which in turn reduces spills or other mishaps that result in environmental contamination. Lastly, lean manufacturing can help the environment because it “creates, within an organization, the orientation to increase employee responsibility and involve employees in waste reduction efforts.” Therefore, by having every employee in charge of ensuring quality, fewer mistakes are made that would have generated excess waste or even resulted in excess pollution.

Despite all these findings, researchers and experts agree that continued, long-term research on the relationship between lean manufacturing and environmental impact is required before this information is used by companies for long-term decision-making.

Case Study: Current Lean Manufacturing Journey at Seaver Finishing: Seaver Finishing is a family-owned electrodeposition facility in Grand Haven, Michigan that paints and finishes metals parts for use in the automotive and office furniture industries. A focus on quality has always been a part of their daily operations since the company was founded in 1953. In fact, Seaver Finishing has a quality policy that states: “At Seaver Finishing, we are committed to achieving organizational goals and providing our customers with complete satisfaction. We accomplish this through meeting their required specifications, performing on time deliveries, offering competitive prices, continuous monitoring and improvement of our facilities and equipment and implementation of teamwork and training throughout the company.”

A key lean concept found in this quality policy is the idea of continuous improvement. However, actual lean practices were not implemented at Seaver Finishing until 2007 when they underwent lean manufacturing training with Lubbers and Associates LLC of Grandville, Michigan. Lubber and Associates LLC did extensive research at Seaver Finishing and presented their findings and recommendations in binders with steps and detailed explanations.

Lubbers and Associates LLC addressed specific topics within lean manufacturing for Seaver Finishing including pareto analysis, or “Law of Disproportionate Distribution” which states that 80 percent of effects come from 20 percent of causes, and 5S, a Japanese methodology for maintaining organization within a company that stands for “seiri,” “seiito,” “seisoku,” “seiketsu,” and “shitsuke,” or, when roughly translated to English, “sort,” “set,” “shine,” “standardize,” and “sustain.” They also provided exercises for two separate training programs: Floor Associate Training Program and Leadership Training.

The Floor Associate Training Program aimed to train hourly employees in four different areas: safety and housekeeping, paperwork, parts handling, and inspection. A key theme of the Floor Associate Training Program was to achieve a “mistake-free” work environment, or simply do all things correctly the first time to avoid injury, extra clean-up, or rework. The Leadership Training focused on two main areas: empowerment and communication. Specifically, Lubbers and Associates LLC provided exercises and quizzes to help the Seaver Finishing management team to analyze and improve their leadership style, to become leaders that empower other employees, and to develop a system of communication that helps other employees feel heard and understood.

Overall, the most significant changes initiated by Lubbers and Associates LLC consisted of assigning more efficient places to keep materials that reduced movement on the shop floor, and getting rid of unused areas, materials, equipment and machines. Lubbers and Associates LLC also provided suggestions and tools to maintain these changes.

Despite the support provided by Lubbers and Associates LLC, the lean implementation at Seaver Finishing mostly failed. According to Henao et al., failure to fully implement lean practices “happens as people return to their previous ways of working, or the focus is shifted to other priorities… only about 10 percent of companies achieve successful implementation of [lean manufacturing] practices. Also, empirical studies reveal a high rate of abandonment of LM implementation in the first three years.” According to the plant manager at Seaver Finishing, he believes their failure was due to high employee turnover and the roles of employees constantly changing.

As soon as an employee learned how to keep an area organized and efficient, he or she would either be moved to a new area or terminated. As a result, the new lean system never “stuck.” Additionally, the new system and consequent training was not taken seriously enough by the management team or the floor associates. There was a lack of interest, ownership and commitment. Without specific project champions, there were no managers to track progress and ensure follow-through. Also, within the training binders compiled by Lubbers and Associates LLC, there are various doodles and scribbles. Some exercises and quizzes were answered with sarcastic remarks or mockery. One page even had the word “Anarchy” scratched across the front.

Henao et al. suggest that there are 3 main reasons why lean manufacturing implementation is unsuccessful: 1) Human factors, including employees’ attitudes towards change, their understanding of lean manufacturing, and their willingness to adopt a new culture, 2) Context factors, the culture at the geographical location of the company, and size and age of
the company, and 3) Sequence factors, which refer to the order in which the various steps of lean manufacturing implementation were executed. For Seaver Finishing, the lack of responsibility from leaders and subordinates surrounding the lean manufacturing training is one clear indication of why the program failed.

Apart from employee cooperation with the program, Seaver Finishing’s lean manufacturing journey is unique for mainly two reasons: 1) Seaver Finishing does not manufacture a product – it provides a service, and 2) Seaver Finishing is a one-process-shop. Day-to-day operations at Seaver Finishing are as follows: 1) Parts to be coated get delivered, unloaded and sorted. 2) Work orders are developed. 3) Parts are processed following work order; required rack or tooling is identified, and rack or tooling is staged. 4) Parts are hung on racks or tooling. 5) Parts are run through an automated painting process that includes a pre-wash. 6) Parts are taken off racks. 7) Parts are identified and packed following work order. 8) Boxes are labeled. 9) Boxes moved to finished goods and held for 24 hours or less. 10) Trucks are loaded, and finished goods are shipped.

During these processes, there are two bottlenecks: 1) The automated painting process which completes a full cycle every 1 hour and 50 minutes, and 2) hanging parts on the racks, which can take anywhere from 1 minute to 8 hours depending on the size of the part, the size of the order, and the number, abilities and efforts of the employees. Because goods are finished and shipped within 24 hours, there is little issue with finished goods inventory and service lead times. Another way in which Seaver Finishing is currently implementing lean practices is by utilizing an “Improvement Log.” The Improvement Log is where anything that did not mean quality standards, by a greater than 2 percent discrepancy, is documented. After being recorded, the impact of that discrepancy is determined, and then a solution is proposed.

In general, it is quite effective. Also, to reduce waste, liners in packaging, totes, drums, and pallets are all reused. Regarding cost reduction, Seaver Finishing often performs analyses to determine whether it is more cost effective to continue paying for machine maintenance for forklifts, boilers and pumps, or to purchase new equipment. They also reduce costs by installing frequency drives on the line that reduce electricity, as well as reducing staggered line start times to avoid spikes in electricity usage. Additionally, simple, visual quality checks are performed at every stage of their processes.

Quality issues generally arise on behalf of the customer, for example, when a customer calls to inform Seaver Finishing that parts that are already being painted are actually flawed. Scrap resulting from internal issues is low, falling into just two categories: 1) Non-coated or light coated parts, which can be prevented by keeping racks clean, and 2) Dropped parts that fall off racks in the paint tank.

Finally, regarding environmentally friendly and sustainable practices, along with reducing electricity consumption, Seaver Finishing reuses packaging, totes, drums and pallets, and ensures that their paint is VOC-, HAPS- and lead-free. From experience, Seaver Finishing believes that lean manufacturing and environmental management work together, not against each other. This happens rather naturally because, as in the case of Seaver Finishing, reducing electricity usage and reusing various plastic, paper and wooden containers reduces cost and the size of their environmental footprint.

**Recommendations for Seaver Finishing**

Based on the literature review and research at Seaver Finishing, there are various areas in which Seaver Finishing can improve its lean manufacturing practices. By analyzing past experiences with lean implementation and noting its failures, the first area for improvement involves managers and leaders.

For lean manufacturing implementation to be successful at Seaver Finishing, top management must be committed to the entire process. This includes commitment in the training process, in goals and objectives, in reinforcing the changes, and in continuous improvement – any leniency or insincerity could be fatal for the project. Managers and leaders must also exemplify the desired organizational culture. For example, if Seaver Finishing wishes to implement quality checks at every single step of the process, essentially making every employee a quality inspector, then the line leaders must visually inspect every part they pick up, and not tolerate employees who ignore this step.

The goal, then, is to pass on this sense of commitment from leaders to lower-level employees and create an expectation of quality that becomes ingrained into the company culture. With the expectation of quality ingrained in the culture rather than quality checks being simply presented as a new rule, it would solve the issue of lean practices not withstanding high employee turnover.

In order to foster commitment, it is crucial that employees at all levels are able to see the bigger picture – that they understand the purpose behind the project, that they can see its positive effects on everyday work and the bottom line, that they have in interest in the implementation, and that they feel a sense of ownership regarding the new system. To communicate the vision, management should educate employees about why they chose to implement lean by holding meetings, training sessions or even showing a video clip that explicitly outlines how their commitment to lean philosophy can increase the company’s profitability, and for employees at Seaver Finishing, their gainsharing checks.

After these larger-scale issues are addressed, there are also a few detail-oriented areas for improvement. First of all, to reduce defects and potential rework, Seaver Finishing should ensure that parts that are already defective are not getting
hung on the line and painted. While the plant manager addressed that the majority of defective parts that get painted are because the customer did not inform them of the defects until after they were painted, training every employee to be a quality inspector while hanging, packing or handling the parts in any way could further reduce this kind of scrap and rework. Additionally, further research could be performed to determine the best way to hang parts to reduce dropped parts.

Despite all the areas for improvement, Seaver Finishing already has many lean practices in place that should be continued. First, both their gainsharing policy and customer review board directly communicate to employees whether or not lean manufacturing practices are being successfully implemented, either by an extra check or a positive review. Also, their use of an improvement log holds them accountable to a certain level of quality and pushes them to continuously improve. Lastly, by recycling all types of packaging and installing equipment to reduce electricity usage, Seaver Finishing has already eliminated a lot waste.

Conclusion
In conclusion, lean manufacturing, a term that defines a philosophy of reducing waste and defects, can have positive effects on the operational and financial performance of a company. And while more long-term research is still required, lean manufacturing seems to also have positive effects on environmental performance. As for Seaver Finishing’s lean manufacturing journey, after analysis and successful implementation and maintenance of some new practices in 2007, they experienced improvements in their operational, financial and environmental performance. However, they still have farther to go in their lean journey, especially regarding the role of leaders, their organizational culture, and full, committed implementation.

References


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