Applying Lean Six Sigma at Acutec Precision Aerospace

William Jones
Penn State University
Black School of Business, The Behrend College
Erie, PA 16563, USA
wmj8@psu.edu

Abstract

The purpose of this project was to apply Lean Six Sigma principles to two work cells currently running in the 5-Axis department at Acutec Precision Aerospace. These two work cells are long-term agreements and will be in production for 10 to 20 years. Because of this, the cells need to be as lean as possible to improve quality and efficiency. Leaning these two cells out were sorely needed. The process was originally producing one part in about 10.5 hours with no standardization and with minimal quality tools present at the work station. Running a 10 to 20-year program under these conditions would lead to quality problems causing delays in shipments and loss of parts due to scrap. This would negatively affect the bottom line as well as Acutec's reputation with the customer. Solving this problem required the use of different Lean Six Sigma tools. In this context, implementation of 5S was a mix of measured success and failure. This was combined with a digital collection system called MeasureLink for inspection data to better track quality through the use of Cpk, bell curves, X –bars, and, R charts. A deburr work station was developed to capture more work on the part at the work station; and, additional inspections stations were created to assist with collecting inspection data. In addition to these tools, special gaging and tooling was purchased to also help with leaning out the work cells. Overall, the project was a success according to management, but the 5S portion was not fully realized.

Key words: Lean Six Sigma, 5S, 8 wastes, Sort, Set, Shine, Standardize, Sustain

Introduction

Being the 5-axis team leader at Acutec Precision Aerospace requires the wearing of many hats. One of these hats is being a project manager (PM), albeit on a small scale. Leaning out the E445 and F247 work cells was a recently completed project that required knowledge of Lean Six Sigma. The project was given originally to a data entry employee from the engineering office, and then to a newly-hired mechanical engineer to accomplish. The team leader involvement at the outset was more of an advisor and expeditor, but later they took over the role of PM. Initially, the team leader volunteered to help educate and guide the PM and push people to get milestones completed. As a supervisor, they felt they could accomplish more than a newly hired mechanical engineer was able to. They had a personal stake in seeing this project through to the end with desirable results as this project would be a direct reflection on the competency of their department. This article is the post-project review of this project.

Scope of the project

Goal

The goal was to completely lean out E445 and F247 work cells to eliminate or reduce the 8 Wastes of Lean Management. The 8 wastes are transport, inventory, motion, waiting, over production, over processing, defects and skills (Leonard, 2016).

The Deliverables

The deliverables are 3 parts per day being produced out of these cells, along with two work cells that appeared to be Lean Six Sigma-compliant, to be used as show-pieces for customers.

Tasks

The tasks involved were:

- 5S for both work cells
- Acquire gaging to complete inspection at bench
- Create a deburr work area in cell
- Implement MeasureLink and establish a Micro-Hite station
- Layout work area to maximize efficiency
- Reach 3 parts-per-day production throughput through lights-out machining and utilizing custom tooling to reduce machine time

Costs

The budget was nonexistent. It was completely open-ended and ultimately up to the discretion of the Director of Operations to approve all requests.

Deadlines

A 90-day deadline was set with the understanding that the custom tooling could very well extend this project out for an additional 90 to 180 days.

Project Achievements

The plan - 5S the work cell (Sort-Set-Shine-Standardize-Sustain)

The plan was made to follow the principles of 5S to accomplish the goal and complete the tasks. 5S is a system or methodology developed by Toyota. The Japanese words and the corresponding English words representing 5S are: *seiri* (sort), *seiton* (set), *seiso* (shine), *seiketsu* (standardize) and *shitsuke* (sustain) (Scheid, 2013). Below are the 5S labels, along with the steps needed to complete in order to fully 5S the work cells.

1. SORT
   - Remove all unnecessary items from work cell
2. SET
   - Buy all gaging needed for inspecting
   - Build work bench
   - Layout gaging and set up MeasureLink on bench
   - Create a Micro-Hite inspection area that communicates with MeasureLink
   - Create locations for parts in process
   - Create a deburr work area
   - Establish an incoming and outgoing zone
   - Finalize set
3. SHINE
   - Establish a shine routine and workload division of labor
4. STANDARDIZE
   - Establish a regular schedule plan for examining the area for shine (place a check list to be completed every week by management to inspect the area for compliance)
5. SUSTAIN
   - Develop a system that encourages the machinists to maintain their environment without oversight

Review of results

Sort was accomplished early and showed dramatic results with the appearance of the work cells. All unnecessary items were removed from the cells, thus freeing up space to be utilized for other components.

Set was only 90% accomplished. The 10% failure was with the gaging. Not all gaging needed was purchased.

Shine was not complete. No set routine was established, and there is no division of labor set to assign certain tasks to the employees in those cells.

Standardize was also not complete. There was no checklist present, and no schedule was made for management to follow-up with assurance that the area stayed in compliance.

Sustain was likewise not complete. The culture of the company did not support 5S, and with no support from the company: the machinists themselves did not have a system in place to follow.

Administrative performances

Current practices in relation to project management

It is observed that current practices of the administration within Acutec regarding project management are weak. There are several areas where this is apparent. First of all, the selection process for choosing the PM was flawed. Not enough thought was given to the qualifications of the person who would lead the project. Upper management would decide that a certain project needs to be done, and then assign someone they felt had the time to accomplish it. This often led to the PM falling into one or more of the four failures indicated above (Cooper, 1998). On this project, the PM was not prepared for this, due to lack of education or experience for leading something of this nature and scope. Initially, a data-entry clerk was the PM, followed by a newly-hired mechanical engineer; whereas, a lean manufacturing engineer with the proper education or experience was needed. In the case of the mechanical engineer, this led to the feeling that their skills were not being utilized, resulting in their loss of interest in the project.

Another area were the top management fails the management of projects is by not following through to the end. In this case, they were extremely engaged at the beginning of the project, interest waning later on. They wanted updates, and were looking for visible improvements. Once the work cells appeared to be leaned out, upper management lost interest. When they lost interest, the PM took the opportunity to quit working on the project and divested totally from it. The PM was subsequently given other work to fill time, leaving the project hanging. This moved the responsibility of completing the project to the team leader, which added workload onto inexperienced shoulders. The team leader was overloaded with the project work, and subsequently the project was left without effective leadership.

Finally, management did not utilize budgets for projects, and would approve or deny purchases for them based on the current state of expenses and their own feelings about whether the project required the requested purchase. This led to their being inconsistent in budget allocations. During this project, the digital gaging needed to lean the E445 work cell out was denied due to cost, and analog gaging was ordered instead. When the aging was ordered for the F247 work cell, digital gaging was not even submitted for approval. The same manager who denied digital gaging for the E445 cell asked why digital gaging was not being ordered for the F247 cell.

Management has shown that there are several of the twelve points to remember that were not remembered. Points 5, 6 and 7 are easy to spot. Point 5 says to lead from the front. For a project to succeed, not only does the PM need to lead from the front, but the administration needs to as well. Point 7 was a failure due to the loss of interest and letting the team disperse before the project was complete. A project will surely fail if the team is dissolved. Point 6 is the main point that I believe management failed at. Management felt the project was complete enough without looking closely to determine if the project was a success (Kharbanda, 1995).

Organizational Structure

Structure for projects

There was no formal structure for project management in the firm. As stated above, the PM typically will have to complete the project they are assigned, as well as attending to their other responsibilities. While working on the project, they may have to answer to multiple people. They are not given much in the way of authority or control. If the employee and stakeholders the project may affect are not buying in on the project, it makes it difficult to complete the project. Management does not have a clear chain-of-command for projects. This makes it difficult for a PM to complete tasks related to the project. In this project, the team leader had to step forward to help expedite a lot of the tasks due to the junior level of the Project Manager.

Team Performance

Team performance was poor. Leadership for this project changed hands three times, resulting in lack of team cohesion. The initial PM was removed and assigned other work, and a new PM was put in-charge. The new PM did not want to lead this project and was not trained in this type of work. The previous PM was slow with rendering assistance and knowledge toward the new PM. This caused frustration and ambivalence towards the project for all involved. Additionally, there was no true champion for this project. A champion is needed to help keep a project on track and moving—and for help with technical understanding, leadership, coordination, control, obtaining resources, and with administration (Pinto, 2016, pp. 127-131). The only incentive to keep moving forward was the threat of upper management being unhappy. The new PM did not know about the 12 points to remember, and could have acquired that knowledge. The new PM also lacked the “3Cs” of planning, communication, and people management skills (Jones, 2018). Overall, poor leadership from upper management resulted in poor team performance.

Techniques for project management

Methods used

The project utilized zero techniques in estimating, planning or cost control. Estimating was done by questioning the inventory representative on the approximate time it would take for gaging. Planning was done ‘on the fly’, and nothing was formalized. Cost control was performed solely by upper management in the form of denying or approving any expenses related to the project.

Tools and Technology

Application and effectiveness

The project did not use any of the many tools available. Gantt charts are very good for planning. This would have helped keep everything on track, and would have given a very visible schedule for everyone to reference. This would also have spurred more excitement between the team and upper management, thus creating a more conducive environment to success. Upper management had always proved to be technologically driven. Utilizing a PERT chart (Jenett, 1972), Gantt chart (Pinto, 2016, pp. 335-337), Critical Path Method (Pinto, 2016, pp. 301-302) or any other technological tool available would have kept the interest alive, and spurred better team work.

Benefits to the Organization and the Customer

Given the many failures of this project, it would be amazing if there were any benefits at all to the organization and the customer. The project goals were to achieve two lean work cells with a result of producing 3 parts per day and having a show-piece for customers.

The benefits for the organization consisted of increased efficiency in the work cells, resulting in 3 parts per day production. Profitability on the jobs was also up by approximately 20% due to the increased production, decreased inspection, and decreased secondary work. More importantly, but harder to quantify, was the increase in customer satisfaction due to their benefits. The end-customers for these two jobs were seeing a more reliable supply and better quality. This allowed them to plan their work to help meet their customer demands.

Conclusion

Overall, leaning out the E445 and F247 work cells using Lean Six Sigma tools was a success. Management was satisfied with the outcome and the work cells were producing good quality parts more efficiently than at the outset. Unfortunately, upper management failed to realize that if the project could be completed as initially planned, the benefits would be even greater. 5S was not entirely implemented before support for the project dwindled, and the resources being applied were diverted to other areas. If these two work cells were to be properly leaned out, profits would increase, quality would continue to improve, and the end-customer would be even more satisfied. Implementation was poor due to upper management not having a solid project management system in place. Costs would have been less, and completion of the project with even better results would have been realized. Also, the team would have suffered less frustration. This would have bred a stronger family feeling to the organization, resulting in a more positive and engaging culture within the company.

It is noted that while the project was not fully implemented, definite gains were recognized. A more robust system was created: better throughput for production; better quality control with quality being built-in; an increase in profits; and, a satisfied customer, were all end-results of applying Lean Six Sigma at Acutec Precision Aerospace. This has been a strong testament to the viability and effectiveness of Lean Six Sigma and showed how manufacturing could benefit from its application despite weak project leadership.

Acknowledgment

I gratefully acknowledge the supervisory and editorial guidance by Dr. Victor Sohmen (Project and Supply Chain Management Program, Penn State University, Erie, PA) in developing this paper.

References

Cooper, K. G. (1998). In J. Pinto, *The Project Management Institute Project Management Handbook* (pp. 396-424). Jossey-Bass Inc.

Jenett, E. (1972, December 1). Project Managment Quarterly. *Choosing your networking technique*, pp. 16-18.

Jones, W. (2018, February 24). *Re: What is your top 3?* Retrieved from https://psu.instructure.com/courses/1926804/discussion_topics/11868042.

Leonard, V. (2016, December 7). *Who is TIM WOODS and why is he killing your business?* Retrieved from LBSPartners: http://lbspartners.ie/eight-wastes-of-lean-tim-woods/

Pinto, J. K. (2016). *Project Management: achieving competitive advantage - Fourth Edition.* Pearson Education, Inc.

Pinto, J. K., & Kharbanda, O. P. (1995, March-April). Lessons for an Accidental Profession. *Business Horizons, 38*(2), 41-50.

Scheid, J. (2013, July 11). *History of the 5S Methodology*. Retrieved from Bright Hub Project Management: http://www.brighthubpm.com/monitoring-projects/70488-history-of-the-5s-methodology/