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Identifying Real Cost Saving in Lean Manufacturing

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Abstract

Lean manufacturing is well-known as an effective means toward cost savings, but to convince management to support a culture shift to implement a lean manufacturing program there must be confidence in understanding what real effective and measurable lean savings are. This case study analyzes data from one specific lean event and points out areas of deficiency and shows how misreporting cost savings can hurt the lean program and the creditability of the lean practitioners. Often, lean practitioners are so anxious to show what benefit their lean projects have attained, they cite everything they can think of to justify their lean project, some of which can be questionable cost savings and can negatively impact the long term credibility of the lean program. This case study from Boeing's Ground-Based Missile Defense (GMD) program will evaluate and confirm what constitutes real cost savings as a result of a continuous improvement project to reduce the cycle time of interceptor integration. This evaluation includes professional perceptions of lean cost savings as part of the conclusion of what constitutes real cost savings in a lean program. This case study evaluates one particular event of many events done by companies every day. Another area of research could focus on instances of lean programs not capturing and reporting all the effective cost savings from a lean project which can have some of the same negative effects as reporting more costs saving than are truly being realized as this study addresses.

Identifying Real Cost Saving in Lean Manufacturing

Lean manufacturing is well-known as an effective means toward cost savings, but to convince management to support a culture shift to implement a lean manufacturing program there must be confidence in understanding what real effective and measurable lean savings are (Ruffa, 2008). This study identifies true and meaningful cost savings as they relate to the sponsoring group investing in the program. This particular case study reviews the efforts of an Employee Involvement (EI) lean manufacturing team in Boeing's missile defense program and the reduction in the cycle time of the integration of an interceptor and how those efficiencies were calculated and presented to leadership and to their customer. Many companies start lean programs, but when times get tough and it is necessary to cut programs, lean programs tend to be at the top of the list. The most likely reason for this is that management is not seeing the true cost benefits of their lean programs (Carreira, 2004).

The goal of this case study is to understand how to calculate cost savings versus increased capacity and cost avoidance. Additionally it will evaluate the downstream affects of how cost savings are reported to leadership based on a lean event that took place at Vandenberg Air Force Base in California in the summer of 2008. It is possible that the reason management is not seeing cost savings from continuous improvement projects is because there has not been any cost savings; in that event, management should either revamp their lean program or drop it altogether. The other reason that lean programs are dropped during down times is that management is not seeing or feeling the actual cost savings reported on continuous improvement projects or that the true cost savings is realized as additional capacity not cost savings. This case study focuses on the reporting of cost savings due to improvements projects and where those savings will be realized in the company. Two specific areas will be evaluated: first, what types

of cost savings should be counted as part of an improvement project; and second, which area of the company reaps the benefit of those cost savings if they are true cost savings? One problem can be that one department is making an effort to improve their processes and putting up the money and resources to do so, but the cost benefits are felt elsewhere in the company. This can be an antecedent to defunding the lean program. Either of these issues can result in a greatly reduced or canceled lean manufacturing program. This case study evaluates a specific continuous improvement project, how the savings were reported and how those savings were actually realized.

Literature Review

The format of this case study focuses on the accounting of cost savings after implementation, what is considered appropriate to count as cost savings from a lean project, and where to post those cost savings. To form the basis of this implementation, a foundation of lean principles is cited. Mann, (2010) outlines how to implement a transformation that cannot fail by developing a culture that will have all the team members involved in the process and invested in the outcome. Mann, (2010) and Wisner & Stanley, (2008) provides the basis for creating an overview of lean manufacturing, and the need for, and benefits of, a corporate lean program.

Much of the literature in this area focuses on all of the benefits of lean manufacturing but there is very little discussion as to where those cost savings should be applied and how to leverage the savings to maximize customer pricing, customer contracts or reinvestment into the company. In trying to create excitement for lean manufacturing programs, lean practitioners can overlook the importance of the application of cost savings (Carreira, 2004).

The research also focuses on specific companies that have implemented a lean program, such as Toyota (Liker, 2003), and Boeing (Jenkins, 2002). The research investigates benchmarking, whereby many companies allow other companies, including competitors, to come in and benchmark how they are doing lean operations and how other companies account for lean savings. Toyota is famous for allowing its competitors to see and learn about their lean program, Toyota believes no other company can emulate the Toyota Production System (TPS), no matter how much their competitors know about it.

The final area to be reviewed will investigate an example of a particular continuous improvement event, the implementation, and cost accounting of a lean project. Using information from Rowlands, (2009), Bowman, (2011), and Ruffa, (2008) the research will identify ways to identify specific lean improvements and understand how to document the improvements as cost savings, cost avoidance or an increase in capacity. Consideration of lean culture will be an important part of the review of its implementation. Marshall (2006) discusses lean manufacturing for improved safety and affordability. This will facilitate a connection between traditional lean manufacturing and the costs associated with lean projects. The research combines the lean program overview and company specific lean programs, with the implementation and cost analysis plans suggested.

Environmental Background

In January of 2002, the Boeing Company introduced Lean Manufacturing to the Integrated Defense Systems (IDS) leadership as an initiative to reduce production costs. The IDS created Employee Involvement (EI) Teams as part of their lean manufacturing program, which reviewed production line data associated with quality, cost, schedule, safety, and lean

culture (Jenkins, 20002). The members of the teams were made up the actual technicians working on the floor, shift supervisors, Industrial engineers and a corporate lean manufacturing advisor. The EI Teams were empowered to identify waste in the production processes, develop actions to minimize that waste, measure the results, develop any additional actions to improve minimization, and then to repeat the cycle continually through the evaluation of current and future state maps. The EI Teams would begin by conducting a Lean Manufacturing Assessment; this assessment identifies areas of waste, evaluates the production areas, 5S program, and evaluates local lean culture. The EI team also developed a "Lean Vision" to describe and communicate to the rest of the program the philosophy of the future of the production line and team expectations.

Methodology

This case study utilizes qualitative research to investigate lean processes and their impact on the overall production environment. The study of Boeing's cycle time reduction project focuses on two areas of the lean project, the tools used to calculate the cost savings and the tools used to present those savings to leadership. The qualitative method investigates the why and how of decision making, not just what, where, when (Hancock & Algozzine, 2006). A smaller but more focused sample of data will be used to define and apply lean cost savings.

Data Collection

Data including, company provided proprietary manufacturing schedules, Accelerated Improvement Workshop (AIW's) reports, cost savings reports and Boeing management responses to company deep dives provided by Boeings lean practitioners will be the primary

information used for this study. Some of this information is proprietary and therefore a Boeing approved summary is provided.

Data Analysis

To support the hypothesis that some lean programs are misreporting continuous improvement gains, this case study analyzes the data from one specific lean event and points out areas of deficiency and shows how misreporting cost savings can hurt the lean program and the creditability of the lean practitioners. In this particular case the research will show how these errors can effect much more than just the one individual lean project.

Case Overview

The summer of 2008 found the production line for the Missile Defense Program at Vandenberg Air Force Base (VAFB), officially called Ground-Based Missile Defense (GMD), behind in its goal to produce one integrated interceptor per month (30 day cycle time). Current production rates put each interceptor delivery at a 44 day cycle time. After continuous pressure from the government customer (US Army), Boeing management turned to its Employee Involvement (EI) Team for a plan to get to deliveries on 30 day intervals.

Case Situation

The EI Team proposed an Accelerated Improvement Workshop (AIW) to map out the production process using the Value Stream Mapping process with the production line technicians. This request was extreme as it moved the production line to a crawl during the event since most of the technicians were involved in the meeting. Management reluctantly agreed and the AIW was held.

The AIW focused on five key issues identifying waste, cellular production, scheduling, production line processes, and production line support:

1. Identifying waste: Waste is the number one cause of out of control costs and schedule delays. Waste is defined as any thing or process that does not add value to a product (Sobek & Smalley, 2008). The identification of waste will guide the output and kaisan improvements for meeting lean manufacturing goals.

2. Cellular production: Production cells combine processes and equipment re-located from segregated areas, employ personnel from all areas of the production line, and will be utilized to process specific sections of the procedure. The cell structure addresses problems associated with excessive travel time, high inventory, higher flow time, higher costs, quality problems, and a lack of product ownership by technicians.

3. Scheduling: The Lean Vision states that the GMD program will utilize simplified scheduling systems where possible to reduce the impact of out of position work. Simplification will be achieved by analyzing the production schedule and reprioritizing activities based on parts availability, out of sequence work for leveling the line and first in/first out (FIFO) for batch processing.

4. Production line processes: The Lean Vision additionally calls for visual and audible controls to replace complex data transfer systems to simplify and improve overall production line communication. Since production cells greatly decreases product movement, additional simplicity will be realized by utilizing visual and audible controls, traveler reduction, and managing post-cell processing.

5. Production line support: The last part of the Lean Vision calls for the production line to set up dedicated support at each of the production cells to address issues as they arise. Cell specific support is intended to improve internal customer focus, optimize production efficiency, and promote ownership of the products and processes.

A thorough evaluation of the current Value Stream Map was performed and 23 individual kaisan improvements were identified in an effort to reach the goal of a 30 day cycle time. The next effort involved the evaluation of the cost savings and schedule reduction for each of the kaisan improvements. Using a basic excel spreadsheet the team concluded that 14 of the improvements were valid and doable resulting in a future state values stream map the presented a cycle time of 23 days and a cost savings of $2.3M per interceptor.

Some of the process improvements included the creation of work teams or cells. Each team had one supervisor or task leader, four technicians, one manufacturing engineer and one quality control engineer. This team had all of the resources it needed to conduct any type of operation and would stay together throughout the production cycles. All team members would work on the floor and be available for any issue that would come up. Another process improvement was dynamic scheduling; the schedule department would identify operations that could be performed in parallel with other operations so that if one of the production teams or cells completed their work early that team could pull another job and work ahead. The team also identified the need for more thorough work instructions to reduce errors made on the floor; the idea was to make Enhanced Manufacturing Work Instructions (EMWI's) using illustrations and cautions of problems previously encountered on the production floor.

Strategic Issue

The event was hailed as a great success, all involved were very proud and excited to show off their process improvements to management and get started with the implementation portion of the plan. All of the necessary deep dive forms and Boeing lean cost saving spread sheets were filled out and submitted to management and the customer. Each of the improvement projects were scrutinized and questioned to the customer and management's satisfaction and shown to be achievable. It was agreed to by all of the players (leadership and customer) that the assessment of a $2.3M savings was appropriate and all of the improvement projects were approved and implemented. Getting to a 23 day cycle time did involve some additional cost in the form of overtime and the purchasing of equipment, these investments were deemed necessary and were approved.

Results

To measure the success of the lean initiatives, the EI Team established performance metrics for the production line. The metrics most analyzed were the cost of implementation and the reduction in cycle time. By the third interceptor since the end of the AIW, all of the improvements from the AIW were in place and after working out some of the bugs, the fourth interceptor was completed in 24.5 days. The fourth interceptor integration flow was used to calculate the following metrics.

Initial reporting of the metrics was as follows:

- 45% reduction in cycle time.
- 28 % reduction in labor costs.
- 60% reduction in time lost due to anomalies.
- 24% reduction in Non-Conformances.

- 89% efficiency rate.

All parties were very satisfied with the results. Since this contract was a cost plus contract the Army expected to see a cut of approximately $24M from Boeing for the next budget year based on the agreed upon costs savings. A surprise to the customer was Boeings fiscal year 2010 bid for 12 interceptors that only had a $1.7M total reduction in cost for the year not the $24M as the government had expected. Why?

Boeing's lean team created mostly additional capacity and cost avoidance with their cycle time reduction not true cost savings. To truly realize the total cost savings Boeing would have to find additional work to fill the void created by the reduced cycle time. Boeing had to pay their employees between interceptors no matter how long it took and the government did not want more than 12 interceptors per year, so Boeings actual cost to the customer went down very little. As a result, Boeings overall labor costs stayed the same. The real value from this lean event is meeting the customer's need of 12 inceptors per year but at little actual cost savings.

Discussion/Conclusions

This is an example of misrepresentation of lean cost savings. It was not intentional but ultimately resulted in a very tense situation between supplier and customer. Unknown to the EI Team was that the original contract had been bid at a 30 day cycle time so the fact that the production line was going over the 30 day cycle time meant that those costs were being added onto the contract using the cost plus structure in the form of an overrun. Although the new cycle time was below 30 days, the fact that Boeing still had the same labor costs and that there were some costs incurred in the implementation of the improvements, made the overall bid for the future contract have only a slight cost reduction.

To avoid this embarrassing situation the team could have done two things; first they could have understood the baseline cost for the current contract and second, they could have categorized their savings into three groups, cost savings, cost avoidance, and indirect savings to understand how these improvements would affect the overall contract.

1. Cost savings are savings that can be directly attributed to the contract, reducing these expenses lowers the overall planned cost of the product to produce.
2. Cost avoidance deals with the reduction of expenses outside of the budget due to errors, rework, or delays in the production line. These improvements are focused on non-conformances and making sure they don't happen again.
3. Indirect savings speaks to the increase of capacity of the production line but does not increase the total number of units delivered, but it does create opportunity to add additional work to the production line.

Lean practitioners need to understand their business. It is not enough to make continuous improvements, publish the "cost savings" and move on, the cost savings for each improvement need to be measured, understood and applied appropriately to the business (Jenkins, 2002). Each change in the business will have consequences, good and bad, and the only way that the company can build a strategy to leverage those changes is to understand the reality the cost reduction efforts.

To further address cost savings, the question about cost savings needs to shift to address the question of what to do with the additional capacity and streamlined production processes (Ruffa & Perozziello, 2000). Brining in sales, marketing and new product development people as part of the EI Team can help with filling in the capacity gap and deliver reduced cost to the

customer. If other work can be found for the production line, the time that the line is working the other work can be reduced from the labor costs of the original contract. This then becomes true cost savings because the cost of the producing on the original contract goes down and those savings can be passed on the customer.

The key outcome of this qualitative research study can be adopted by any lean practitioner to help effectively implement a lean manufacturing reporting system and gain the maximum possible effectiveness from the program. Lean savings are best viewed as a long term proposition; there is much pressure to show immediate savings, revenue growth, productivity improvement, reduction in defects, reduced cycle times and corporate culture are all areas that will continue to produce savings long after the term of the Return on Investment (ROI) have run out. Companies that do not practice smart lean manufacturing are doomed to mediocrity and ultimately failure (Liker, 2003).

This study should be used by industry to appropriately report cost savings of a company's lean program. It can be part of decision-making processes as to whether or not to take on an improvement project, based on the actual benefit to the company and the department doing the project. This study creates demarcation points for cost savings on continuous improvement projects; this will be a point of contention as many lean practitioners will count all possible savings as part of their (ROI) in order to boost the cost savings of their projects.

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