International Review of Applied Engineering Research.
ISSN 2248-9967 Volume 4, Number 1 (2014), pp. 33-38

http://www.ripublication.com/iraer.htm

Study of Productivity Improvement Using Lean Six Sigma Methodology

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Abstract

Lean Six sigma has become a popular term in manufacturing and business world. Many success histories of companies that applied the methodology have been published. This paper reviews the productivity improvement project using Lean Six Sigma tools focused to improve the bottleneck activity in project department of industry. Bill of material generation activity is one of critical activity at the start of the project which gives requirement of various parts to the planning department. But that bill of material generation activity takes very much time which affects the productivity of department. The paper briefly touches on the history of Lean Six Sigma and six sigma project execution methodology which helped to achieve reduction in time & increase of accuracy of that activity. Depending on the purpose every organization will have to find a proper way and a combination of methodologies in its implementation process. The PDCA (Plan–Do–Check-Act) cycle is a well-known fundamental concept of continuous-improvement processes, DMAIC (Define-Measure-Analyze-Improve-Control) is a systematic, and fact based approach providing framework of results-oriented project management, DFSS (Design For Six Sigma) is a systematic approach to new products or processes design focusing on development activities.

Keywords: Lean, six sigma, bill of material, productivity, project department, DMAIC, DFSS.

1. Introduction

1.1 Lean

Lean is a philosophy and set of management techniques focused on continuous "eliminating waste" so that every process, task or work action is made "value adding"

(the real output customer pays for!!) as viewed from customer perspective. Lean "waste elimination" targets the "Seven Wastes" namely:

- Transportation of material
- Inventory
- Movement or motion of human
- Waiting time
- Overproduction
- Over processing
- Defective items

1.2 Six Sigma

Six Sigma is a business management strategy, originally developed by Motorola that today enjoys wide-spread application in many sectors of industry. It seeks to identify and remove the causes of defects and errors in manufacturing and/or service delivery and business processes. It uses a set of management methods, including statistical methods, and creates a dedicated infrastructure of people within the organization who are experts in these methods. Six Sigma aims to deliver "Breakthrough Performance Improvement" from current levels in business and customer relevant operational and performance measures. Business or operational measures are elements like:

- Customer Satisfaction Rating Score
- Time taken to respond to customer queries or complaints
- % Defect rate in Manufacturing
- Cost of executing a business process transaction
- Yield (Productivity) of service operations or production
- Inventory turns (or) Days of Inventory carried
- Billing and Cash Collection lead time
- Equipment Efficiency (Downtime, time taken to fix etc.,)
- Accident / Incident rate
- Time taken to recruit personnel

Six Sigma initiatives are planned and implemented in organizations on "Project by Project" basis. Each project aims not only to improve a chosen performance metric but also sustain the improvement achieved. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified financial targets (revenue increase, cost reduction or profit increase). Six Sigma projects follow two project methodologies inspired by Deming's Plan-Do-Check-Act Cycle. These methodologies, composed of five phases each, bear the acronyms DMAIC and DMADV

a) DMAIC (Define, Measure, Analyze, Improve, Control)
   This is used for projects aimed at improving an existing business process
b) DMADV (Define, Measure, Analyze, Design, Verify) is
   This is used for projects aimed at creating new product or process designs

1.3 Bill of material generation process

The bill of materials (BoM) is, in its simplest form, a list of parts or components required to build a product. It provides the manufacturer's part number and the quantity needed of each component. At its most complex, the BoM is a multi-level document that provides build data for multiple sub-assemblies (products within products) and includes — for each item — part number, approved manufacturers list, mechanical characteristics and a whole range of component descriptors. It may also include attached reference files, such as part specifications, CAD files and schematics. Within a company, the BoM served as a means of tracking product changes and maintaining an accurate list of components needed to build products. As manufacturing has become increasingly distributed, the BoM has taken on even greater importance, serving as the primary reference file for product data. It is used to transfer product information from OEM (Original Equipment Manufacturer) to main supplier and then to its vendors and suppliers. As outsourcing expands the number of companies involved in the manufacturing process, the need for accuracy is more critical than ever. At the same time, the transfer of manufacturing data across multiple companies magnifies problems and increases challenges. As the primary conduit for data transfer among manufacturing partners, the BoM is central to the product life cycle from the very beginning.

2. Case Study

2.1 Define Phase – Problem statement

At the start of the year engineering team has target in departmental Goal Deployment Plan of improvement of cycle time of project engineering activities by minimum 25%; thus to help to improve the customer satisfaction. The Champion also explained the strategic objectives of retaining and adding new large customers and customers' expectations of quality, short order cycles, and low price. The team thought that the goals were daunting, but agreed to begin the Define Phase with the understanding that they could revise the goals after they had gathered more information. The team discussed the OE (Order Entry) process; almost everyone was intimately familiar with it. They agreed that the scope was correct and that they could get through the project in the time allotted. The Champion told the team that their agreed-to draft Charter would be published to the rest of the organization, to make their work highly visible. The Champion also informed them that their results would be publicized to the rest of the organization. The team developed the following process interaction chart very quickly. Every order moved through six activities in the process:

- Incoming Order Screening
- Spec Entry into the ERP (Enterprise Resource Planning) System
- Price Checking
- Job Planning,
- Inventory Check
- Manufacturing Schedule - Assigning a plant and group of equipment and scheduling the order to run in available time slots.

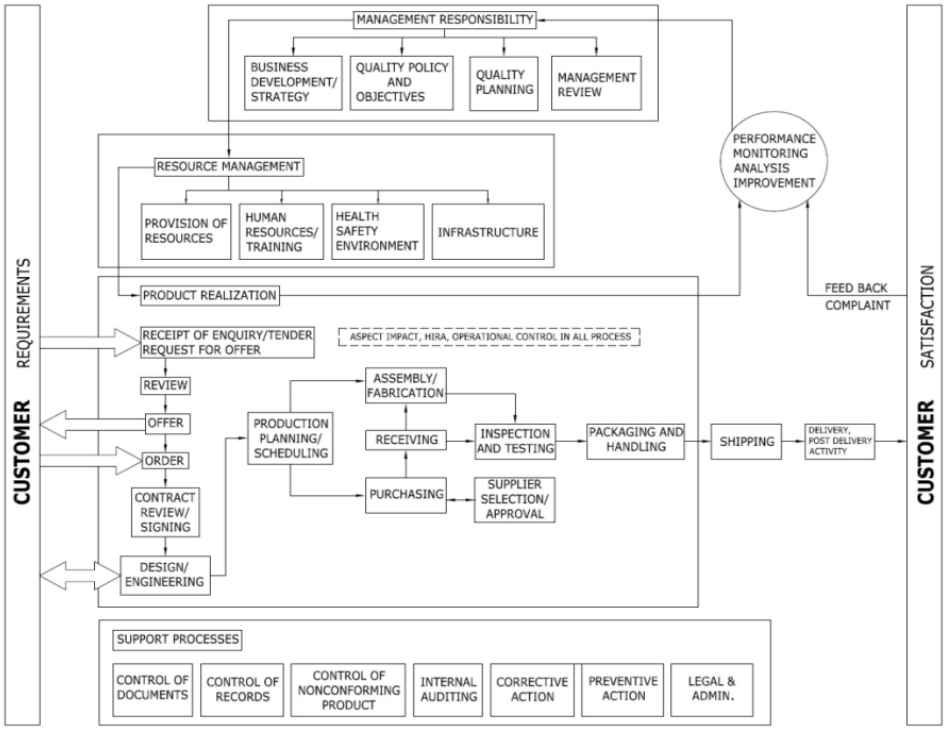
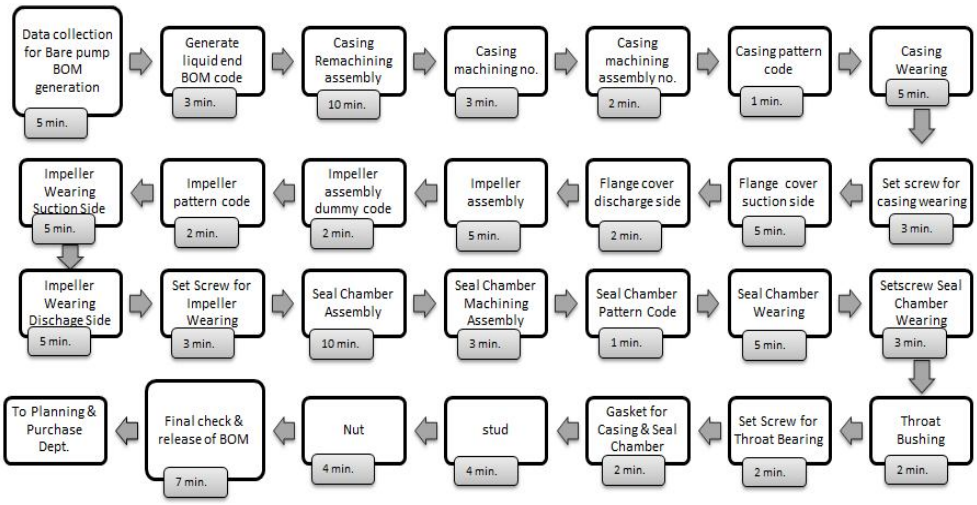


Fig. 1: Process interaction chart.

2.2 Measure Phase

The Champion accepted the team's report on their Define Phase work and approved them to proceed to the Measure Phase. To gather as-is measurements of time required for different activities and errors happening during the BoM preparation, they planned to review the 25 number old orders BoM produced by projects team in last 6 months & 25 number of new orders BoM. High demand could pressure people to work quickly, and that could increase errors. In each sample they planned to check to see if any errors had been detected and reported by the customer or by any internal department, time required to complete that activity. That information was available as historical records going back two years So the lead time sub-team would be able to determine actual lead times of new versus repeat orders, and lead times by product complexity. They could also measure lead time for orders with and without errors. The team proceeded to execute their measurement plans. The data gathering took several weeks and the sub-teams reported status like total time required to prepare one BoM is average 104 minutes which was very huge considering daily minimum 5 BoM considered for each project engineer.



Source: ITT Industries website.

Fig. 2: This diagram shows the time required to complete the various activities for BoM generation process.

2.3 Analyze & Improve Phase

The team reported that they had brainstormed possible root causes with the help of cause & effect diagram, Pareto chart and developed cause & resolution sheet to improve the lead time & accuracy of BoM. Team was asked to validate these possible causes and report back to the whole team about ideas on how to change these drivers.

Cause & Resolution sheet		
Casue	Solution	Benefits
Typological error	Develop Software to avoid typological error. In this software all data will be in drop down menu.	Minimum manual entries to reduce the errors
Non-awareness of coding	80% of parameters will be selected based on pump model in automatic sheet/ software to avoid errors and reduce the total time	time reduction & improvement in accuracy
Repetitive entries/Data	Software / sheet will intimate the repeated entries and avoid the entry	Time reduction of BoM generation activity
Improper pump knowledge	Recurrence awarness training to new joinees & referesher training for old employees about the pump	First pass yield will be improved

Source: ITT Industries website)

Fig. 3: Cause & resolution sheet.

In second brainstorming session, champion gave suggestion that to solve these issues and make user friendly sheet, they can use Microsoft excel with visual basics code so that lot of variation can be incorporated. So after that team worked with internal expert and developed an automatic excel sheet which gives the intimation of errors like repeated entry of same code, wrong material code entry etc. and with one click it give full BoM sheet saved in project folder with order acknowledgment number & benefits after improvement are 80% reduction in lead time, 33% improvement in accuracy & 60 % capacity improvement in BoM generation activity.

2.4 Control Phase

After the team received approval from the leadership team to implement their solution, they executed the development of automatic Microsoft Excel sheet & now to control this project, team have written down the standard operating procedure to use that automatic BoM generation sheet and BoM accuracy measurement & lead time measurement is included in project department KPI (Key Performance Indicator) for effective monitoring of the project. At the end, champion and team celebrated the success of the project for motivation of the team.

3. Conclusions

The organization continued to apply the Six Sigma Management Process to its organization in its drive for continuous improvement. Leadership eventually realized breakthrough results throughout the organization by aligning, accelerating, and governing activities and the rigorous work of the Lean Six Sigma continuous process improvement teams.

The case study here described gives a clear indication of high returns of invested time of team for Lean Six Sigma methodology implementation. Lean Six Sigma is the logical next step for a company pursuing excellence in existing process or products, also designing new products and services. Lean Six Sigma focuses on delivering both Lean speed and Six Sigma defect-free quality.

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