Lean on Time & Production Efficiency

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Abstract

Introduced by Toyota, Lean is a technique applicable across any industry-small, medium or large scale. Scope of improvement persists throughout the life of an organisation; in its products and policies as it is rightly said that only constant in any system is continuous change for improvement. This paper focuses on the scope of Lean in assembly process of an aircraft manufacturing company which is also an exporter to Boeing. The case study identifies the areas of implementation of Lean which would help the company benchmark its production process and achieve reduction in costs. An observational study revealed that the assembly suffers the menace of non-availability of parts which leads to considerable employee idle time and this in turn hints at the need for improvement in Supply Chain function of the organisation. Time study conducted at the assembly gives the management an insight into the excess manpower employed for the assembly process which adds to the cost and recommends the management to revise the standard rate fixed time for different operations which would help eliminate the overtime working, reducing cost.

Keywords: Lean, Supply Chain, Idle Time, Time Study, Continuous Improvement

Introduction and Theoretical Development

The objective of the study is to analyse the approach of organisation towards the adoption of

Lean manufacturing, the problems faced in the assembly process, and the possibilities of Lean in improvement of efficiency of the production process. Apart from a technique, Lean is a philosophy or a culture which helps a firm to achieve the objectives of cost minimisation and profitmaximisation. According to Womack, the master of Lean Manufacturing, Lean technology is pivoted on the ideas like use less of anything unlike in mass production, half the space for manufacturing and human effort in the factory. Lean is a means to improve quality and productivity by elimination of all non-value adding elements in the value chain including inventory, lead time and other manufacturing wastes which can even be the excess expenditure on labour. Lean principles which can be employed as a catalyst in enhancing the production efficiency is well described in the book "The Machine

That Changed the World" (1990) by James P. Womack, Daniel Roos and Daniel T. Jones, and "Lean Thinking" (1996) by James P. Womack and Daniel T. Jones.

Three key principles of Lean, preached and popularised, are waste minimisation, continuous improvement, and flexibility in production. The case focuses on the 'elimination of waste' aspect of Lean which means eliminating all non-value adding activities and resources adding to the cost of production. In order to implement Lean ideologies in the assembly line the first and foremost activity is to perform VSM (Value Stream mapping) to map the existing process. Once the process is mapped the flow will be simplified and all possible wastages of material, movement & method need to be studied. Lean will help in successively overcoming all the obstacles to linking every step into a continuous flow sequence, precisely synchronized with the demand of the end customer. Lean basically involves perfect first-time quality through quest for zero defects, revealing and solving problems at their ultimate source, achieving higher quality and productivity simultaneously, and teamwork and worker empowerment.

Key Lean principles are:

i. Waste minimisation by removing all non-value adding activities making the most efficient use of scarce resources (capital, people, space), just-in-time inventory, eliminating any safety nets.

ii. Continuous improvement (reducing costs, improving quality, increasing productivity) through dy-

namic process of change, simultaneous and integrated product/process development, rapid cycle time and time-to-market, openness and information sharing.

iii. Flexibility in producing different mixes or greater diversity of products quickly, without sacrificing efficiency at lower volumes of production, through rapid set-up and manufacturing at small lot sizes.

Continuous improvement involves a blend of Kaizen or 5s, Total Productive Maintenance, Total Quality Management, 5 WHY, Mistake Proofing, and Root Cause Analysis. Bottlenecks in the point of view of operations is the constraint in any system which affects the attributes of production like throughput time, cycle time, and delay in process. But another way of looking at bottlenecks is as indicators of the scope of improvement in any process which is one of the underlying principles of Lean manufacturing. Continuous improvement in any process is the non-contradicted principle behind any quality process. The production processes are facilitated by numerous factors including men and machine and each of these has varying degrees of impacts on the overall performance of the process. Production planning also has to be carried out in a way that ensures high degree of responsiveness. Bottlenecks hamper the capability of process in maintaining delivery schedules and thereby the customer requirements. For any business, sustainability and growth depends on how competitive it is in responding to market demands and customer requirements by making efficient use of available resources.

Assembly process in manufacturing happens towards the end of production and hence it has great impact on meeting delivery schedule. Timely availability of raw materials and subassemblies which meet standards of quality is very important prerequisite for a smooth manufacturing process flow. Any process is a set of interrelated and interconnected upstream and downstream activities and cumulative efficiencies of each of these determines the overall efficiency of the process.

The case analyses the production process and finds out the major bottlenecks and non-value adding elements which can be the starting points for various improvement initiatives. The study is carried out in a leading aircraft manufacturing company in India which also is a supplier of Uplock Box Assembly. The process study also helps to validateif the existing capacity in terms of manpower is sufficient to meet the expected increase in customer demands in future.

Methodology

When looked at, in its most basic form, there are only a few true physical limitations to increased output time, money and the marketplace. For most products, given enough time and money, any bottleneck can be overcome. In the short term, however, very real bottlenecks may exist in your operation. The bottleneck identified in Assembly shop was non-availability of detail parts.

The Uplock Box Assembly is attached to the Main Landing Gear Wheel well and is used to secure the Main Landing Gear of an aircraft in closed position. Each set delivered to the client consists of two Uplock boxes (LH & RH) and each box is an assembly of 5 subassemblies and a main assembly.

Different stages in each subassembly are independent of other stages and proceeds serially. The main assembly is the stage where integration of all the five subassemblies takes place to form the finished product.

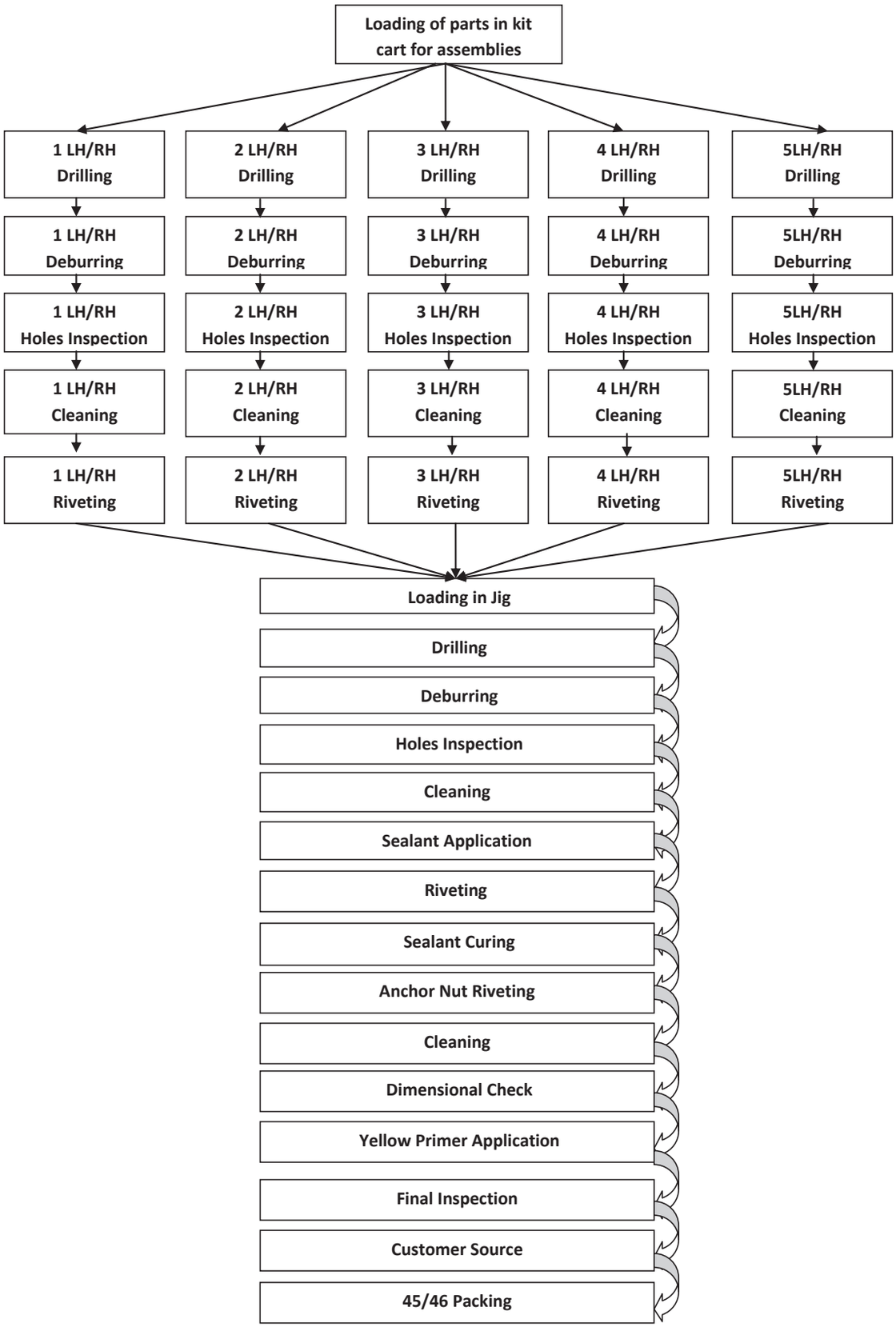
The parts required for each assembly are packed and supplied in the form of a kit. Each assembly uses a specific set of parts and components like stiffeners, fittings and brackets made of aluminium sheets, extrusions and plates.

Detail parts required for the Uplock Box production consists of machined parts and sheet metal parts. Machined parts are manufactured from bar stocks and materials and sheet metal parts are manufactured from sheet metals. To overcome capacity constraints and bring higher cost efficiencies remaining 48 parts are outsourced and 2 parts are manufactured in-house. Out of the 50 machined parts 10 parts which undergo shot peening process come under critical status and hence many critical parts do not become available on-time causing unexpected halt in production.

The subassemblies 1 and 5 are the subassemblies which face the starving due to non-availability of parts. Non availability of critical components can lead to the delay in production of subsequent stages which in turn have negative impacts on the production efficiency and there have been instances where the firm could not meet the delivery schedules.

A survey was carried out among the supervisors and technicians engaged in the assembly process. Based on the feedback collected from the technicians and supervisors, the major difficulty faced by them in the production operations was found to be the non-availability of critical parts. Major assignable reasons for this are the higher lead time of components requiring shot-peening and the

Figure 1: Flow Diagram of the Production Process



lack of adequate number of indigenous suppliers. There have been several such observable periods during which the production was stopped for the entire day and the technicians are so trained for the project that they lack skills to be engaged in any other works during the idle time.

There is a need to redesign the supply chain and procurement processes of the firm to overcome barriers to process improvement and consider the possibilities of manufacturing such components with high lead times in house. This needs a make versus buy decision making supported by cost-benefit analysis. The technology needed to support the production can be very costly and may be either purchased or licensed and both the alternatives are equally expensive to the firm. A practice adopted by manufacturing intensive companies is vendor development which is also a feasible solution to make parts available on time.

Time study is a tried and tested method of work measurement for setting standard time of doing specific work. The intention in carrying out Time study is to establish time for qualified worker under stated conditions at a defined rate of working. The manpower capacity is analysed by observing the work, recording what is done and then timing and simultaneously assessing the rate of work. Basic time is the time required to carry out a particular work at standard rate. Extra time is allowed for various conditions including the relaxation allowances. Observational studies carried out in the shop floor shed light on the additional manpower available in the assembly and the idle time that occurs due to unavailability of components at required time. Idle time refers to that time during which the workers spend their time without giving any production or benefit to the organisation. Reason for incidence of idle time can be non-availability of raw materials, shortage of power, breakdown of machines, etc.

Data Analysis

In operations management context capacity is a relative term which may be defined as the amount of resource inputs available relative to output requirements over a particular period of time. The capacity level selected by any venture has a critical impact on the response rate, its cost structure, its inventory policies and its management and staff support requirements. If capacity is inadequate, a company may lose customers through delayed services and if the capacity is excessive, the company is forced to underutilize its workforce. So it is always better to have an optimum capacity in terms of all the resources including labour force.

In this study an effort has been made to assess the manpower capacity in the Uplock Box Assembly and it also tries to determine if the existing capacity is enough to meet the future needs of the customer.

Assumptions of the Study

- The actual cycle time for the Uplock Box Assembly is very less compared to the standard rate fixed time
- All parts are available at the right time as per the schedule.
- There is no delay in operations due to breakdown of machines or other equipments.
- Labour efficiency is 100%
- Working hours per day is taken as 7 hours after allowing for breaks in a normal single shift
- There are 26 working days per month
- Current customer requirement is 9 sets per month

Table 1: Manpower Capacity Analysis

Present Customer Requirement		9 sets per month
Assembly	LH	RH
No of technicians	3	4
Available Monthly Manpower Capacity	3*7*26 = 546man-hours	4*7*26 =728man-hours
Cycle time of Uplock Box	17 hrs 27 min	19 hrs 37 min
Time required for 9 sets	9* Time required for one set = 157 hrs	9* Time required for one set =177 hrs
Excess capacity(in MH)	546 – 157 = 389	728-177 = 551
Excess manpower	397/(7*26)~= 2.18	561/(7*26)~=3.08
No. Of additional boxes that can be produced with existing manpower capacity	397/(17 hrs 27 min) ~ 22 Boxes	561/(19 hrs 37 min) ~28 Boxes

The throughput time determined as a result of Time Study conducted in the shop floor for RH and LH assemblies are 17hrs 27 min and 19hrs 37 min respectively.

Thus the capacity analysis proves that the manpower available at present is more than sufficient to meet the future expectations on increase in rate of production of Uplock Boxes by the customer.

The organisation under study can use the existing facility and manpower to increase the production to the tune of 22 boxes per set operating only single shift and without opting for overtime or installation of additional Jigs.

Research Constraints

The research outcomes are highly industry specific and are valid based on the underlying assumptions. The observations are subjected to changes which vary from a public to private sector enterprise. The organisation under study being a public sector undertaking has numerous drawbacks and restrictions growing out of the hierarchy of its organisational structure and also the regulations imposed by Government. While there are tightened control systems in place in a private organisation, the public sector has inherent diseconomies and unlimited flexibility. Such firms focus more on social aspects like providing mass employment, infrastructural development of the facility location and so on and are less lucrative in terms of cost efficiency and profitability.

Conclusion

Analyzing the production process, it is found that the major bottleneck in the production of Uplock Box Assembly is the non-availability of critical parts at the right time. The shortage of parts is common with the detail parts requiring shot peening and the lead time for such parts is more than one month.

Manpower capacity analysis put light into the fact that the available manpower is more than the actual requirement. Also it substantiates the possibility of an increase in production with the existing capacity even if the customer requirement becomes 20-22 sets per month.

This can be achieved with the single shift operations and does not demand multiple shifts and overtime production. The study makes evident the further possibilities in process improvement which in turn can bring about increase in production efficiency.

Proper design, planning and implementation of Supply Chain can get the production process out of the major constraint it is facing right now which is the non-availability of parts at the required time. Waiting for parts disrupts the flow which is one of the serious kinds among 7 Mudas of Productionin Lean manufacturing. Excess manpower inventory is a non-value adding resource which is another Muda among the seven preached and practiced world-wide. Hence it is also an area of improvement where there is a wide scope for implementation of Lean.

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