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Case Study of Utilization of Production Line by Using the Lean Manufacturing Methodology &Techniques.

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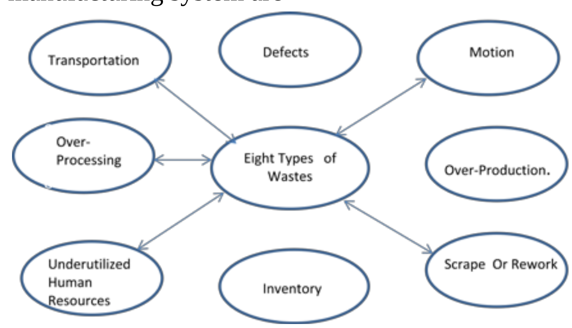
Abstract-
Lean manufacturing has received a great deal of attention in its application to manufacturing companies. It is a set of tools and methodologies that aims for increased productivity; cycle time reduction and continuous elimination of all waste in the production process. In this paper a case study is presented in which bottlenecks are identified in the assembly shop of the Trucks and Buses manufacturing automobile company due to which the productivity was low. Thus, by using the methodology and tool of lean manufacturing reduced the bottlenecks through change in the design specification and tolerances in the component. Key words- Utilization , Hub End Play ,Rear Axle Assembly, shim

INTRODUCTION

Assembly lines are one of the most widely used production systems. Productivity of a manufacturing system can be defined as the amount of work that can be accomplished per unit time using the available resources. Pritchard (1995) defines assembly line productivity as how well a production system uses its resources to achieve production goals at optimal costs. The conventional productivity metrics, namely throughput and utilization rate gives a significant measure of the performance of an assembly line.

These two components unaccompanied are not enough to completely represent the behavior of a production system Huang *et al (2003).* A set of other measures such as assembly line capacity, production lead time, number of value added (VA) and non-value added (NVA) activities material handling, operator movement, , work-in-process (WIP), line Layout and others, along with the throughput and utilization rate, completely distinguish the performance of a production system. An assembly line yields optimal performance by an optimal setting of all these factors.

The aim of Lean Manufacturing is the elimination of waste in every area of production including **c**ustomer relations, product design, supplier networks, and factory management. Its goal is to incorporate less human effort, less inventory, less time to develop products and less space to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible. Essentially, a "waste" is anything that the customer is not willing to pay for. Typically the types of waste considered in a lean manufacturing system are



Eight Types of Wastes

LITERATURE REVIEW

Starting in the early 190's Henry Ford "married consistently interchangeable parts with standard work and moved conveyance to create what he called flow production.'' Not soon after WWI the Toyota Production System, TPS, introduced lean manufacturing concepts into the manufacturing industry. Lean Manufacturing has increasingly been applied by leading manufacturing companies throughout the world. It has proven to have many positives outcomes which include such concepts as reduced cycle time, decreased cost ,reduction of defects and waste . According to Womack Jones, and Roos, [6] lean manufacturing uses less of everything compared to mass production ,half the human effort in the factory, half the manufacturing space, half the investment in tools, and half the engineering hours to develop a new product. In addition, it requires keeping far less than half of the needed inventory on site, results in many fewer defects, and produces a greater and ever growing variety of products. Ohno (1988) [7] coined the seven wastes targeted by lean manufacturing initiatives: (1) defects (activities

ISSN 2348 – 7968

involving repair or rework), (2) overproduction (activities that produce too much at a particular point in time), (3) transportation (activities involving unnecessary movement of materials), (4) waiting (lack of activity that occurs when an operator is ready for the next operation but must remain idle until someone else takes a previous step), (5) inventory (inventory that is not directly required to fulfill current customer orders), (6) motion (unnecessary steps taken by employees and equipment), (7) processing (extra operation or activity in the manufacturing process).(8) Underutilization of employees has been added as an eight waste to Ohno's original Waste. Russel and Taylor, (1999) [8] explained that the major purposes of the use of lean manufacturing are to increase productivity, improve product quality and manufacturing cycle time, reduce inventory, reduce lead time and eliminate manufacturing waste. To achieve these, the lean manufacturing philosophy uses several concepts such as one-piece flow, kaizen, cellular manufacturing, synchronous manufacturing, inventory management, poka-yoke, standardized work, work place organization, and scrap reduction to reduce manufacturing waste.

Shah and Ward (2003) mention that Lean manufacturing has become an integrated system composed of highly inter-related elements and a wide variety of management practices, including Just-in-Time (JIT), quality systems, work teams, cellular manufacturing etc. Bhasin & Burcher (2006) remark that Lean is not only tools and techniques, but it should be viewed as a philosophy. It is a 'way of thinking' and not a mechanism to action these thoughts. Wilson (2010) states that Lean system strives to make one piece at a time, this is true one piece flow. Last few years had seen plenty of researches into the area of manufacturing improvement such as lean manufacturing, total quality management, total productive maintenance and their application within various manufacturing companies such as automotives, electronics, plastics components and etc. Majority of research studies have shown lean manufacturing as the best manufacturing system in the 21st century.

Key Principles of Lean Manufacturing

1. **Recognition of waste-** The first step is to recognize what does and does not create value from the customer 's perspective. Any material ,process or feature which is not required for creating value from the customer 's perspective is waste and should be eliminated . For example , transporting material between workstation is waste because it can be potentially be eliminated.
2. **Standard processes-** Lean requires an the implementation of very detailed production guidelines, called Standard Work, which clearly state the content ,sequence, timing and outcomes of all action by workers. This eliminates variation in the way that workers perform their task.
3. **Continuous flow-** Lean usually aims for the implementation of a continuous production flow free of bottlenecks, interruption, detours, backflows or waiting. When this is successfully implemented, the production cycle time can be reduced by as much as 90%.
4. **Pull-production**-Also called Just –in-Time(JIT), Pull –production aims to produce only what is needed ,when its needed . Production is pulled by the downstream workstation so that each workstation should only produce what is requested by the next work station.
5. **Quality at Source –** Lean aims for defects to be eliminated at the source and for quality inspection to be done by the workers as part of the in-line production.
6. 6. **Continuous Improvement-**Lean requires striving for perfection by continually removing layers of waste as they are uncovered. This in turn require a high level of worker involvement in the continuous improvement process.

CASE STUDY

This Paper presented a case study of Line utilization of assembly shop (Rear Axle Assy) by using lean manufacturing tool.

A. Problem Identification

Overall line utilization of rear axle assembly was badly affected in the head of Technical Service Dept.

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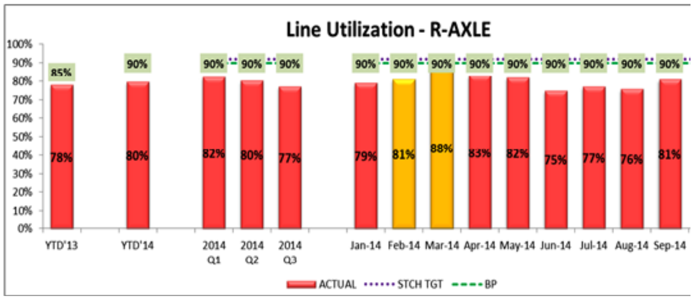
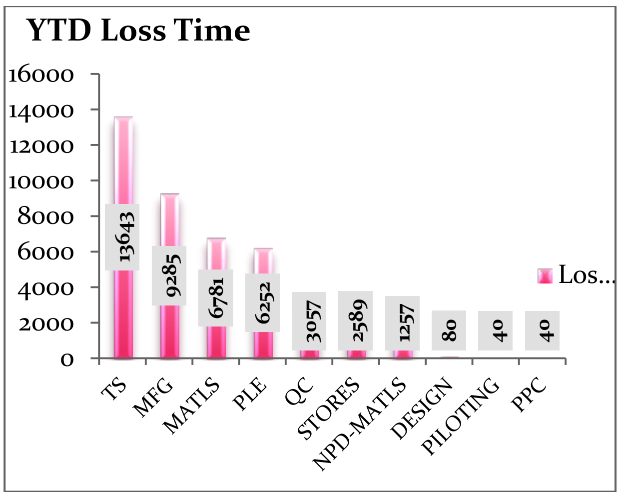
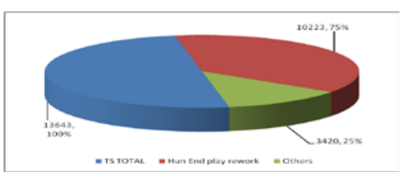




B. Data Collection

By doing the study and scrutinizing the data of Line loss(Rear axle assembly) shop, it was found that the major bottleneck was Hub End Play Rework.



C. Analysis

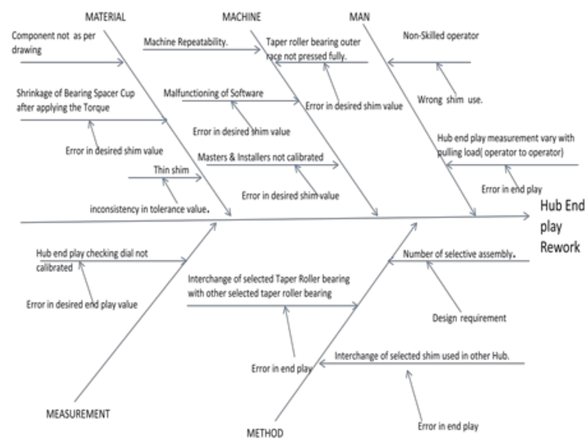
1. Possible Causes (Brainstorming):

The first step in analysis is to find out the number of causes that can be the reasons behind the Hub End Play rework. 12 No of causes that were generated during the brainstorming session are as follows-

- Non-Skilled operator
- Machine Repeatability.
- Masters & Installers not calibrated
- Malfunctioning of software.
- Component not as per drawing.
- Thin shim.
- Taper roller bearing outer race not pressed fully.
- Shrinkage of Bearing Space Cup after applying the Torque.
- Interchange of selected shim used in other Hub.
- Interchange of selected Taper Roller bearing with other selected taper roller bearing
- Number of selective assembly.
- Hub end play checking dial not calibrated.
- Hub end play measurement vary with pulling load(operator to operator) .

2. Possible Cause and Effect Diagram:

Now a cause and effect diagram is prepared for the possible causes. This diagram is also known as Ishikawa or the Fish bone diagram and is shown in



From the analysis of all the possible causes, three probable root causes are responsible for Hub End play rework in Rear axle assembly shop.

S. No.	Probable causes	Observation
1	Number of selective assemblies in Rear hub due to design constraint.	Due to number of selective assemblies and tolerance in the component , the end play value was not justified the current specification of Hub end play i.e. .20µ~60µ (Range 40µ)

ISSN 2348 – 7968

2	Thin Shim	Thin shim should come in 15µ ~20µ tolerance.
3	Shrinkage in bearing spacer cup after load applied.	Bearing spacer cup shrinked after the applying the torque of 30~35kgm. It create gap of some micron inside the selective assemblies which gives false value of End play after the fitment of Hub.

D Action-To eliminate each root cause

Kaizen idea for Root cause 1:

Design specification of Hub end play has to be revised as per stack up tolerance calculation.i.e.(10µ~80µ)

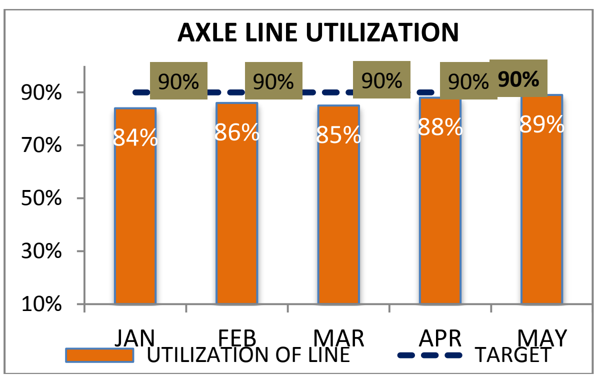
Kaizen idea for root cause 2:

Design has to be revised & thick spacer can be used in place of thin shim of 15~25µ tolerance value.

Kaizen Idea for root cause 3:

Material of Bearing spacer cup has to be changed.

After implemented the proposed Kaizen the utilization of line has drastically improved.



V.RESULTS

Thus, by using the lean manufacturing- kaizen technique the bottlenecks were identified in the Rear Axle assembly shop an were removed by change in design of shim ,Revised Hub end play specification & bearing spacer cup , the line utilization of rear axle shop significantly moved up 77% to 88%

VI. CONCLUSION

Based on the result of this study, the resource utilization at production line has been improved from the current condition to the modified condition. For example, after the modification, the utilization at Rear axle shop changed from 77% to 88 %. The results of our study have very important implication for the company. In terms of the major concern of the company, the study shows a direction that would lead the company to improve its resources utilization.

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