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COMBINATORIAL ANALYSIS OF LEAN MANUFACTURING AND REVERSE ENGINEERING FOR JOINT PROPELLER SHAFT IN AUTOMOBILE INDUSTRY: A REVIEW

Manish Deshmukh[1*], Anshul Gangele[2], Deepak Kumar Gope[3]

[1]*Research Scholar, Depart of Mechanical Engineering, Shri Jagdishprasad Jhabarmal Tibrewala University, Jhunjhunu, Rajasthan, India 33001*

[2]Priciple, Depart of Mechanical Engineering, adina institute of science and technology, Sagar, Madhya Pradesh, India 470002

[3]*Assitant Professor Scholar, Depart of Mechanical Engineering, Shri Jagdishprasad Jhabarmal Tibrewala University, Jhunjhunu, Rajasthan, India 33001*

Abstract

A wheel's axle is its middle shaft. Axles keep the wheels in place in relation to one another and to the vehicle's frame. Attempts are being made to address this problem in this publication. A comprehensive review of the relevant literature is now being conducted, and several potential study avenues have been identified. Lean Manufacturing is a fast-growing and efficient strategy in today's competitive marketplace. Lean Production is used to continually remove wastes from the manufacturing process in order to increase productivity and efficiency. It is the primary goal of lean manufacturing to meet the needs of the customer in terms of quality and cost. In addition to identifying the root causes of waste, the method helps to remove it by establishing clear rules and norms. This article focuses on the fundamentals of lean manufacturing in order to increase production, quality, and decrease the product's cost. Various wastes have been classified. The methods for reducing waste are explored in detail.

Keywords: Axle; Drive Shaft; Lean manufacturing; wastes; continuous improvement; manufacturing industry

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1. INTRODUCTION

Manufacturing has been around for a long time and was initially carried out by experienced craftsmen, often with the help of helpers, who passed on their knowledge via apprenticeship. There may have been guilds that protected the craftsmen' trade secrets and privileges. Alternatively, manufacturing may take place on a smaller scale in rural regions, where artisans would use their home-based manufacturing to augment their farming income. The putting-out approach was used to organise these industrial homes into joint ventures.

1.1. Types of losses in manufacturing

In the 1970s, the "Japan Institute of Plant Maintenance" established the Six Big Losses framework, which identifies industrial losses and gives criteria for analysing efficiency issues. Proactive improvements are encouraged in the framework, which focuses on reducing faults, delays, and breakdowns.

Finding the fundamental cause and scope of each of the Six Big Losses may be a difficulty. This approach may be used to break down problems into manageable chunks, which can subsequently be used to build long-term solutions.

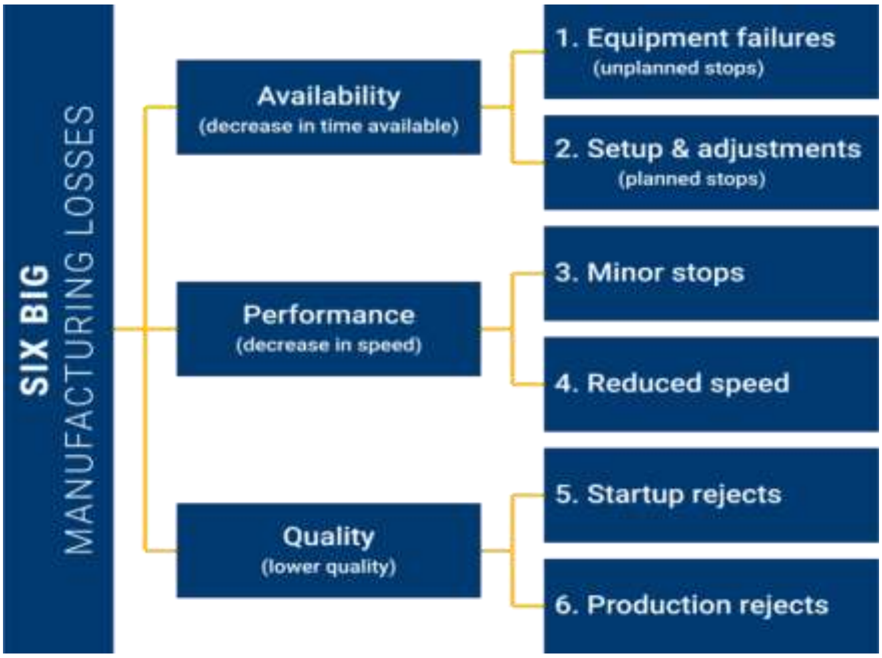

Figure 1: Six losses of manufacturing

1.2. Quality Losses

Process Defects

During steady-state manufacturing, process defects are responsible for the fabrication of faulty items. First Pass Yield takes into account both trashed pieces and those that can be repaired. Defects in the process are a Quality Defect.

Incorrect machinery settings, operator or equipment handling mistakes, and lot expiry are all examples of typical causes of process faults (e.g., in pharmaceutical plants). (Meena et al., 2016)

Reduced Yield

Defective components created from the commencement of production to stable (steady-state) manufacturing are included in the concept of reduced yield. First Pass Yield (OEE) takes into account both trashed pieces and those that can be repaired. However, it is most typically recorded following a transition, when equipment is restarted for the first time in a long time. Quality is harmed when yield is reduced.(Wei Dong Leong et al., 2019)

Equipment that requires warm-up cycles, equipment that produces waste when it is first used, and inadequate changeovers are among the most typical causes of reduced yield (e.g., a web press).

2. LITERATURE REVIEW

(Hore, 2019) This study is being conducted to fill a gap in the literature and provide a plan for implementing lean in an effective manner. A hierarchical model of lean implementation in the Indian steel sector is the topic of this investigation. Interpretive structural modelling is employed in this work to develop the hierarchical model, which is validated using MICMAC analysis. Following the formulation, the model was decrypted and advice were offered on how to effectively adopt lean in the Indian steel sector.

(Sundareshan et al., 2017) The Indian Foundry sector employees are surveyed extensively to study the deployment of Lean and the determining elements. The results of a research looking at age, firm size, educational background, gender, and years of experience in the context of the Indian subcontinent's Lean implementation reveal a jumble of data that obscures the causes, advantages, and obstacles to its adoption. There are 28 foundries in Karnataka, and a total of 204 employees filled out a detailed questionnaire to get their thoughts on the industry. Overall equipment efficiency, plan-do-check-act, total productive maintenance, bottleneck analysis, continuous flow manufacturing, poke yoke, as well as standard work are among the most successful categories of Lean, according to the findings of the study. The chi-square distribution's standard deviation numbers show the same thing.

(Womack & Jones, 2015) To attain this aim, lean manufacturing and related techniques are seen as a crucial tool for eliminating or reducing waste. It is thus necessary to develop a quantitative model to examine if lean manufacturing processes (tools) may enhance the company's sustainability performance in all three of these areas (economic, environmental and social). An extension of prior research, this study examines relationships between sustainability and lean techniques in terms of the triple bottom-line components of the triple bottom line.

(Erick et al., 2014) (Erick et al., 2014) In this work, CAD/CAM (Computer Aided Manufacturing) methods and composite materials are proposed for the design and manufacture of low-capacity wind turbine blades. TIMEO®, a programme created at the author's university, was used to create the blade designs. A three-axis CNC machining machine, DYNA MYTE DM-4800, was used to make the blades model. The final manufacture of composite materials was performed. The design requirements for a 600 watt wind turbine were based on the environmental conditions around the coast of Michoacán, Mexico, where the blades were constructed. Wood is used to make the blades model using mechanical milling, which is a manufacturing method in which a spinning cutting instrument known as a milling cutter removes metal. Internal structure designed to offer stiffness and flexibility in the final fibreglass manufacturing process.

(Cudney et al., 2014) Using a virtual simulation, students may play with lean ideas and learn about them in a safe environment. The need for engineers who have a thorough knowledge of lean principles necessitates exposing students to these ideas as early as possible in their education. Learning lean ideas via hands-on projects and simulations may be replicated using a virtual simulation platform created by a team of researchers. An intuitive user interface, the capacity to save findings, and the modelling capability of state-of-the-art virtual reality software are just some of the features of the platform available. With the VE-Suite virtual engineering framework, a user-friendly conversation box, graphical models, performance display gauges, and a changeable layout are all included in the platform.

3. LEAN MANUFACTURING

It is a manufacturing technique based on the idea of optimizing productivity while decreasing waste in a manufacturing activity, which is called lean manufacturing. Waste, according to the lean philosophy, is everything that does not provide consumers with more value for the money they are prepared to pay.

The advantages of lean manufacturing include shorter lead times and lower operational costs, as well as increased product quality and less waste.

Lean manufacturing, often known as lean manufacturing, is based on certain manufacturing concepts that have affected production systems across the globe, as well as those in healthcare, software, and numerous service sectors.

Lean principles: Forging the foundations of today's lean manufacturing practises was Japan. When Eiji Toyoda set out to enhance Toyota's production procedures, he hoped to boost sales and profit. This collaboration with Taiichi no resulted in the design, development, and implementation of many lean manufacturing technologies. When James Womack and Daniel Jones published their book Lean

Solutions, they outlined the five principles of the Toyota Production System. (Panwar et al., 2015) (Prof & Kitaw, 2014)

The Five Lean Manufacturing Principles

Toyota's success may be attributed to the five lean manufacturing principles, which can be used by companies to make products that are tailored to their consumers' needs. (Goshime et al., 2019)

Figure 2: Five principles of Lean Manufacturing

3.1. Advantages of Lean Manufacturing

a) Waste Minimization:- A manufacturing facility's waste may be reduced to a minimum with the help of lean manufacturing. There are several advantages to lean manufacturing, but one is the most important. Anything that doesn't provide value to the process might be considered a waste of time. Transport and over-processing are all examples of places where trash is often generated. This technique removes obsolete or ageing inventory since organisations have a lot of inventory and trash to deal with. The operation's expenses are also reduced by this method.

b) Enhanced Customer Relationships:- Lean focuses on the problems and ideas of long-term consumers in order to eliminate some of the inefficient procedures. Instead of trying to please everyone, organisations may concentrate on their most loyal consumers in order to develop long-term, trusting relationships. As a result, your customer interactions will improve and your loyal consumers will provide you with a consistent stream of income.

c) Lean Infrastructure:- In a lean infrastructure, the building, tools, materials, equipment and personnel are all you need to meet short-term inventory needs. With the facility, the facility is able to get as near as possible to production efficiency.

3.2. Approaches of Lean

The “Toyota Production System (TPS)” has long been linked with lean production, which helped propel Toyota to international prominence. As a result of Eli Whitney's systemization, some scholars believe that it may be traced back to the Industrial Revolution. Lean manufacturing is often compared to the Six Sigma method of process improvement. If you're looking to adopt lean manufacturing, the TPS is an excellent approach.

That in mind, here are eight steps to help you implement lean manufacturing practises in your business:

Get rid of the trash immediately. In lean manufacturing, this is a foundational idea. A value stream analysis is a common tool for spotting inefficient processes in a manufacturing facility. Additionally, you may step up efforts to develop more efficient methods to improve the company's product range, which is a good strategy. (An example of waste is shown in the right-hand box.)

Reduce wasteful stock. In most cases, the expense of holding on to extra inventory surpasses the potential advantages. Slow reaction times and more complicated quality-control difficulties may be a result of this. If any of the inventories becomes outdated, as is often the case, then having too much on hand might be a real concern.

Process time may be reduced. It used to take days or even weeks to finish a task, but today it can be done in only a few hours. Put to good use the technical resources you now have. Lean manufacturing adherents advocate producing products in small quantities so that future iterations may be enhanced with “bells and whistles”.

Reduce response time. Manufacturers have been stressing the need of accurate market projections for years. Although this may be the best strategy in a fast-paced atmosphere, it isn't always the best option. You may instead build an agile system that can respond quickly to market changes.

Ensure that all components of the product have been thoroughly checked for quality. To catch issues at the earliest possible stage, implement testing and control methods at many checkpoints throughout the process. The system must be fine-tuned to discover flaws, rectify them, and move on.

Employees should have more freedom. Give more staff the power to make choices and equip them with the necessary tools and methods. You may take this a step further by forming teams to track success and improve your methods. Employees at all levels of a company are often able to come up with creative solutions to problems. It's also good for morale and productivity because of this sort of participation.

Ask for consumer input. Systematically get feedback from consumers after establishing the product's primary features. Over the course of the system's lifecycle, it should be able to adapt to new situations. In order to meet client demands within your fundamental framework, you need take this step.

Get in touch with your suppliers. Make suppliers "partners" in the lean manufacturing process when it is suitable. The advantages of lean manufacturing may be experienced by all stakeholders when suppliers cooperate with the application of lean manufacturing concepts. Strengthening current business contacts is also an important benefit.

4. CONCLUSION

“Lean Manufacturing” implementation may be hindered by the need for planning, dedication, method, learning, and safety. This study examines lean manufacturing principles and technologies. It also stresses the need of identifying the many sorts of waste in a company. Overall, the paper provided guidance and methods for exploring and implementing lean manufacturing ideas in an organisation in order to increase productivity, efficiency, and quality of the finished product. – As a result, the price of the product is kept lower. As a result, any firm may use lean manufacturing to cut down on unnecessary waste.

Despite the numerous advantages of lean, there are still several obstacles that might be used to prevent its adoption. Lean implementation is hindered by a number of factors, including poor psychology, lack of responsibility, financial difficulties, a lack of education and training, and volatile demand. Without a doubt, the instruments of lean principles must now be used by all sectors if they want to stay in business. It's time for every industry to get rid of their old ways and adopt lean approaches. In order to preserve their jobs, workers in the industrial sector need to modify their mindsets.

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