A Systematic Lean Approach and Its Improvements in a Manufacturing Assembly Line

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Abstract

Lean Manufacturing is a well known method of waste reduction in manufacturing, which is applied widely and brings a lot of benefits. As a result, there are a large number of companies applying lean in manufacturing and achieving success. This paper presents a process to transform a traditional production line to a lean production line. Here a case study in an automotive company of applying lean tools and techniques in manufacturing assembly line was executed by applying lean methodology and the potential benefits were achieved. This research work provides new insights into the assembly line of the company and the successful implementation of lean tools and other quality techniques was incorporated. The paper also discussed the benefits of time study, worker utilization which will leads to a greater improvement in the production line.

Keywords: Lean Manufacturing, Assembly line, Layout design, NVA elimination

1. Introduction

During the advancements within the recent years, application of lean thinking obtains advancements and has become brand new generation steerage thinking of management revolution. Lean thinking refers to eliminating wastes by distinctive non worth further activities thorough out the provision chain. Lean methodology or lean production has attracted immense interest from each academicians and practitioners [1]. Technical aspects of lean thinking are wide mentioned. The term and initial application of Lean thinking introduced by Ford and his association at Highland Park (Detroit), in 1913. They targeted within the potential of flow in terms of a way to cut back the number of effort required collecting an automotive by ninetieth without the necessity of any effort.

Hence, they took a call to line up the production line into continuous flow with no loss of productivity throughout producing. Since these days, several firms round the world changed into Lean thinking and that they will be a part of Lean thinking advantages. This project is concentrated on these production lines in terms of a way to improve them by applying Lean producing Techniques. From a typical man purpose of interest, the essential rule of Lean thinking is to get rid of waste. Waste may be outlined as something that doesn't add price to the finished product or doesn't offer any profit for organization. [2]. With this globally competitive market, Indian producing firms ought to endlessly explore for ways in which to scale back overhead and manufacture prime quality product. With the goal of reducing the take time and up the method potency this study was conducted

at an organization that manufactures. During this technique, productivity was increased by up the standard and eliminating the waste from the system therefore it minimizes the value of the merchandise and so it improves the client satisfaction. Lack of exposure and lack of information relating to the implementation of the lean thinking in their producing method had created these little makers towards lean thinking thought. With this globally competitive market, Indian producing corporations got to unceasingly rummage around for ways in which to scale back disbursal and turn out top quality product. With the goal of reducing the take time and up the method potency this study was conducted at a corporation that manufactures many product one in every of that is that the massive earth moving instrumentality (LEME) [4]. The thought of method sort layout was mainly used throughout the promotion of radical changes just in case of producing method structures. Moreover, the popularity given by this method sort layout don't suit the simply in time philosophy. But the look based mostly lean thinking system typically the vital idea that was chiefly needed for pushing for sales. The plant push their outputs to retailers, retailers square measure returning what they can't sell and came back merchandise winds up as a dead inventory [5].

2. Literature review

In the present day to day life all the manufacturing industries are mainly concentrating for occupying the entire market of their product for themselves. In order to achieve this they were employing this lean thinking by using this they had attained knowledge of minimizing waste and promoted the product customization by shortening the production cycles. To design a system for work piece positioning at intervals a producing machine with improved accuracy and dependability, leading to higher quality for the finished elements and within the hindrance of problems that may have an effect on work piece quality and cause their rejection were resolved by implementing varied lean tools [6].
For many years, lean producing follow has been thought-about reciprocally opposed. On one facet, the philosophy of lean is “less is better”: which means so as to boost company performance, inventory, variability, material handling, and quantity of waste should be reduced the maximum amount as potential. Conversely, IT philosophy is “more is better”: IT tools permit to raise manage additional info, enlarged flexibility, functions and options. However, in line with the 2 categories of instruments are complementary each within the thought and within the application: IT tools are a sort of higher-level coming up with system, whereas lean practices were associated with shop-floor management and execution activities. Lean tools appear to be applied in balance, which means that organizations tend to hide a large vary of techniques even though individual tools don't seem to be totally enforced. Additionally, the associate analysis reveals that an ineffective implementation of some lean practices would possibly hamper their positive effects [7].

3. Research Background

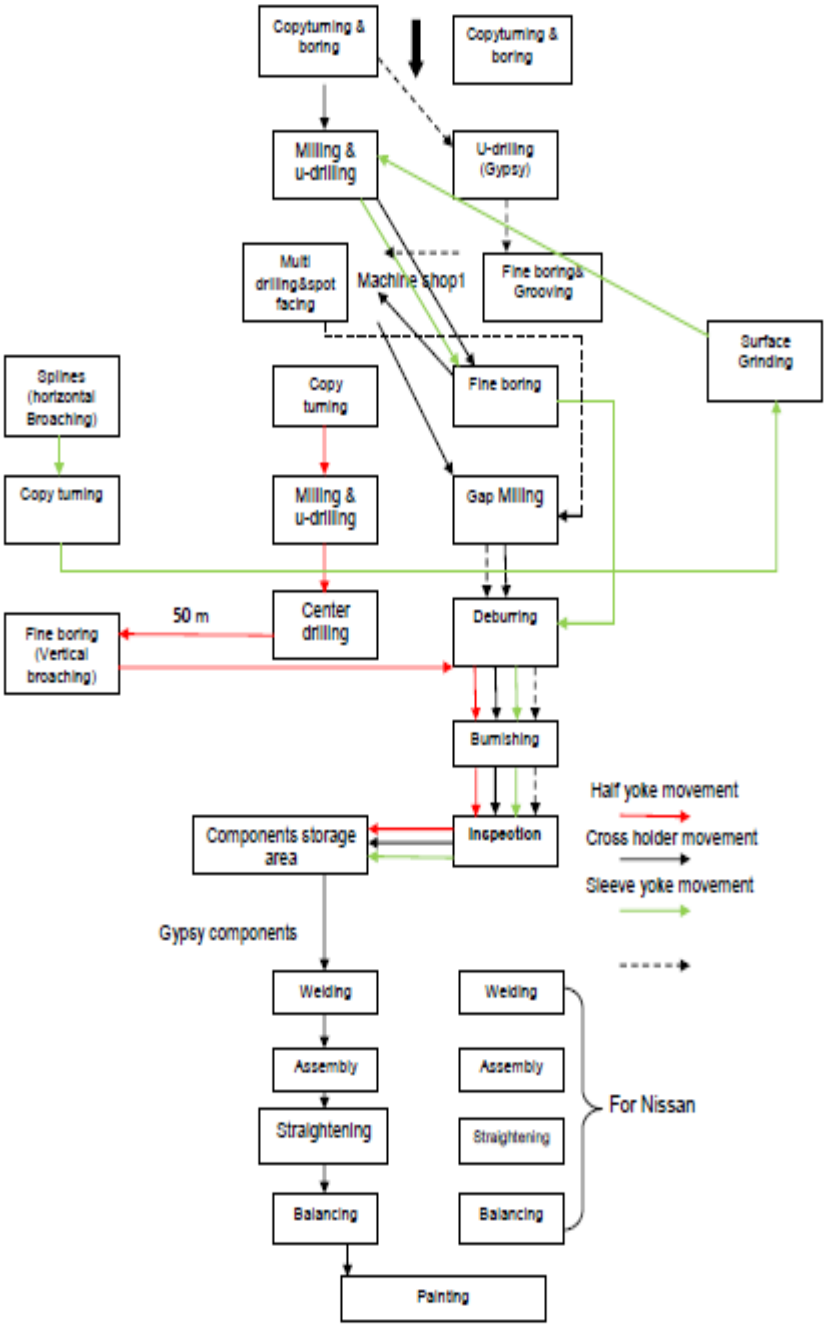
The assembly line in the machine shop ‘I’ involves the assembly of cross, flange yoke and end yoke with the tube yoke. Assembly process is carried for the models of Gypsy and Omni of the Company. The above said components assembly is currently done manually by using a dedicated assembly line. To perform time study about the process the sequence of steps carried out in each and every sub-process was identified. A spreadsheet was prepared to collect time for all the sequence of process for the available samples. The root mean square is used here as a measure of the magnitude for the data’s collected which gives a sense for the typical size of the numbers.

4. Problem and Method Description: A Case Study

The purpose of the study is to perform time study on the existing cross-assembly process and to collect information about the time taken for performing each sequence in the assembly process that shall be used for benchmarking in the automation of the universal joint cross assembly process.

The scope of the study involves identifying the steps involved in each process and measuring the time taken in performing each action.

ASSEMBLY LINE: THE PRODUCT FLOW



5. Data Collection and Analysis

Table 1

CYCLE TIME DATA						
PRODUCT NAME	**PROCESS**	**AVERAGE TIME(sec)**		**PRODUCT NAME**	**PROCESS**	**AVERAGE TIME (sec)**
Cross holder	Copy turning & boring	101		**Sleeve yoke**	Broaching spline	22
	Milling & u- drilling	149			Copy turning	94
	Fine boring	81			Surface grinding	116
	Multi Drilling & Spot Facing	172			Milling & u- drilling	149
	Gap Milling	27			Fine boring	81
	Deburring	64			Deburring	65
	Burnishing	12			Burnishing	11
	Inspection	9			Inspection	19
PRODUCT NAME	**PROCESS**	**AVERAGE TIME (sec)**		**ASSEMBLY PROCESS**	**DESCRIPTION**	**AVERAGE TIME(sec)**
Half Yoke	Copy turning	43		**Welding**	Punching number on the shaft	186
	Milling & u- drilling	98			Pressing of the Half Yoke On Both Side Of The Shaft	
	Fine boring	16		**Assembly**	Sleeve yoke mounting process	170
	Deburring	64			Flange yoke mounting process	
	Burnishing	12		**Straightening**	Run out measurement and pressing	185
	Inspection	8		**Balancing**	Checking the unbalance and welding the balancing material	70
	surface grinding	116				

Problem Identification

- **Work In Process Inventory (WIP)**

The flow of work piece gets bottle neck between copy turning and subsequent milling and u- drilling process. It creates an unnecessary Work In Process (WIP) inventory between the two operations.

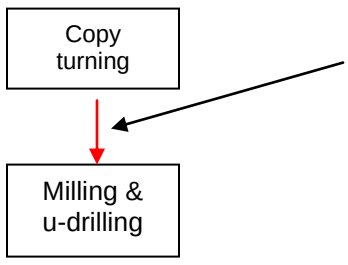


Fig 1: Stagnant components

- **Unnecessary Transportations**

In the process sequence of center drilling, fine boring and deburring, the product motion is studied. After completing the center drilling process, components are taken to vertical broaching machine area for doing fine boring. After completing, it is being taken again to maruthi line for doing Deburring process. During this transportation, more time is consumed. A Total of 1.6 hours travelling time has been reduced in this process.

- **Inspection At Inappropriate Stage**

In the process sequence of straightening, balancing and painting, the inspection for jerk and oscillating torque are conducted after painting process. If during inspection any quality is not satisfied it is sent back for rework in assembly line. Due to this the rework process interrupts the regular production and the back flow of the product occurs. The poor quality cost tends to be increased and the rework time is also gets increased.

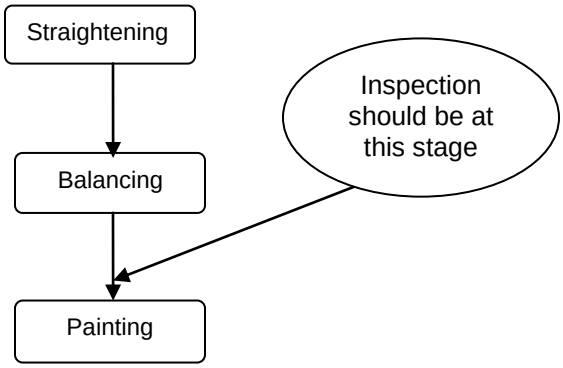


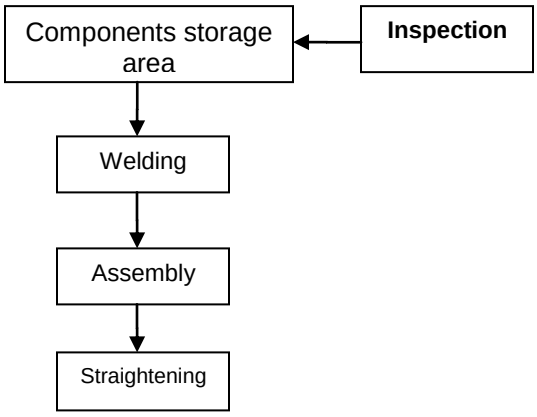
Fig 2: Rework being done on the painted shaft

- **Improper Segregation**

Machined components after completing the inspection process are stored in boxes. For the subsequent assembly process the components are retrieved from these boxes. The storage of machined components is not segregated in a shift basis.

The segregation of quality components was not performed in this stage, so there is no accountability of defects while assembling is done. Due to poor inspection and monitoring of machined components the material cost is increased which creates a greater impact at this stage.

Fig 3: Components storage boxes



6. Implementation, Results and Discussion

The work in process inventory can be reduced by balancing the reported cycle time and reducing the bottleneck. This can be achieved by simultaneously doing both copy turning and center drilling process with a single man worker there by eliminating the inventory burden in the process sequence.

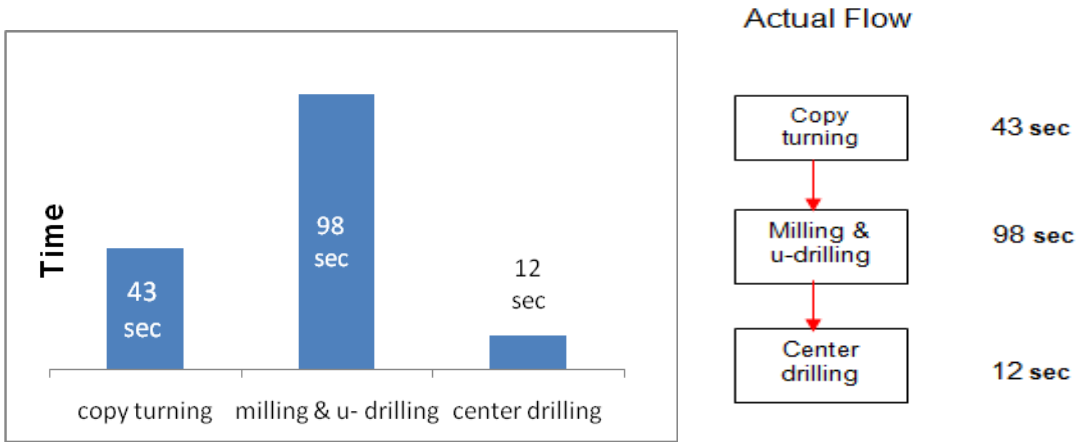


Fig 4: Actual Process

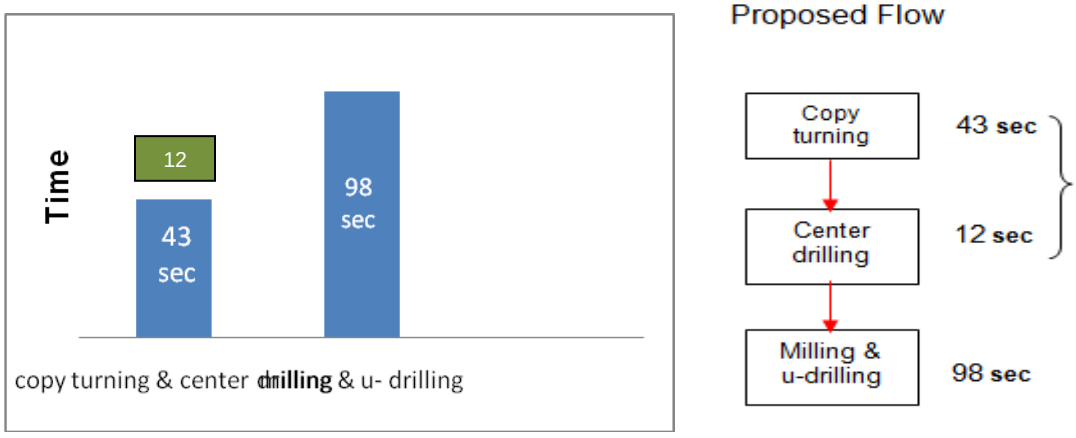


Fig 5: Comparison graphs

- **Eliminating Unnecessary Transportations**

For avoiding the unnecessary material movement during the fine boring process of half yoke we can use the Fine Boring machine (machine number BG 03),instead of vertical broaching machine. The fine boring machine is used for machining gypsy components only. After that it is kept in ideal.Since the cross holder bore dia and half dia are the same (25mm)both can be done in the same machine.it eliminates the unnecessary time involved in man and material movement. Inspection should be conducted after the balancing operation, it reduces the cost and rework time, it eliminates back flow of the product.

- **Adequate Data Monitoring**

For monitoring and collecting effectively machining time, material flow, machine performance and workers utilization data, a job card should be maintained. A format of job card is shown. By using this job card for monitoring and collecting data, productivity, overall equipment effectiveness and worker utilization can be improved.

7. Conclusions

A comprehensive time study was made on the existing cross-assembly process of the desired product. The time study has provided with information that the more time consumption has been reduced in all the possible processes, further the material movement was streamlined. Complex steps and sequences were identified with the help of time study and the collected data can be used for improvement of the process in many ways. These improvements were made in the shop floor of the production line and the non value added happenings was reduced to a greater extent.

8. Scope of Future Work

Since the time involved depends on the worker's skill, time study shall be carried out with different workers in different shifts for better performance. The awareness has to be created among the top management and the workers in the shop floor to avoid unnecessary practices and the concern wastes. Further the experimentation is to be carried out for each product flow line based on the lean methodology has to be carried out in order to achieve smoother and quality process.

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