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A Review on Implementation of Lean Manufacturing in Maize Grinding Mill Assembly Line

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Abstract

At present scenario, lean manufacturing has become a worldwide phenomenon. It is quite successful in drawing the attention of companies of all sizes. A large number of organizations are following the lean technologies and experiencing vast improvements in quality, production, customer service and profitability. Lean manufacturing is a systematic approach to identify and eliminate the waste through continuous improvement. The manufacturing industry in India must also look to leverage its advantages, its large domestic market, good conditions in the terms of raw materials, skilled labour and the quality focus. Many manufacturing organizations realize the importance of practicing lean techniques. However, few organizations apply lean techniques with the necessary knowledge and proven tools to achieve it. A value stream includes all the operations and processes to transform raw materials into finished goods or services, including non-value adding activities. Value stream management is a management tool for planning a production process involving lean initiatives through systematic data capture and analysis. It is a proven process for planning the improvements that will allow companies to develop lean practices. The purpose of this study is to develop a value stream map for Ganga R.K. industries. This particular tool allows the company to document current lead time, inventory levels and cycle times to determine the ratio of value added to total lead time of the product line being analyzed. The first step will be to create a current state map to make a picture of the production flow and understand the company's current cycle times, process communications, and machine equipment capacity. This provides the information needed to produce a future state map by creating a vision of an ideal value flow, although that will not be done in this study. The goal is to identify and eliminate the waste, which is any activity that does not add value to the final product, in the production process. In order to collect the information needed to complete the project, the work should be done within the assembly facility. This will enable the firsthand knowledge of the production flow and to be familiar with the activities being performed at the shop floor. In addition, observe and collect information related to product families for the practical mapping and product/process flow from start to finish, calculating takt time from data collected by the host company. The researcher will document cycle times, down times, work-in-process inventory (WIP), and material and information flow paths. This information will enable the researcher to visualize the current state of the process activities by mapping the material and information flow and looking for opportunities to eliminate wastes and to improve the process flow. Based on all the information gathered, the company will utilize these results as a plan to map the future state and implement lean manufacturing. Ganga R.K. industries are growing so fast and expanding their businesses while managing their time, inventory, labour, quality and other production factors in order to increase productivity and output while reducing waste. For that, lean manufacturing aims to reduce the inventory and gain more profits while getting a better quality of the goods delivered to the customers. The aim of this article is to assess and explain, through a survey, to which extent lean tools are implemented in a Ganga R.K. industry and to find out if there is any relationship between the application of these tools (Value stream mapping, JIT, TPM and standardization) and the effectiveness of lean on the productivity.

Keywords: *Lean, total productivity maintenance, takt time, just in time, standardization, 5S*

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INTRODUCTION

Industries around the world manufacture different types of products and deliver them to the customers in order to satisfy the market need. These products pass through a whole process, since the receipt of the raw materials from the supplier, going through all the manufacturing, packaging and testing stages until the delivery of the final good to the customer.

Many authors described "lean manufacturing" as a strategy aiming to decrease waste, costs and increase productivity of the firm. This concept evolved over the years and many companies across the globe tried to implement it while others preferred to adopt the traditional manufacturing process and resist change. It generates a production cost reduction, manufacturing time cycle decrease, inventory reduction, higher quality, flexibility, higher profits and cash flow improvement. In this article, we will define the lean manufacturing strategy, starting from its origin and concept, then describing all the methods and tools followed in order to achieve the best productivity of the firm while reducing the wastes.

For this, we will take the case of Ganga RK. industry that has its plant in Rajkot-Gujarat, manufactures locally then delivers the products and services to the customers in South Africa and in several countries across the globe. The wastes that are occurring in the Ganga R.K. industries are reducing the productivity leading to higher cost and to lower quality of the finished goods delivered to the clients. These wastes have a negative effect on the performance of these firms, their profitability and their output. The aim of this study is to identify, through a survey to which level lean manufacturing is being implemented in the production department and this on the different employees' levels and to identify if a relation exists between the application of lean tools and the productivity of the firm.

Problem Definition

This concept is focused on assembly line for the reduction of cycle time in the assembly of maize grinding mill assembly. The planned production in one shift for an assembly line is 100 maize grinding mill machines. But, the actual production is only 80–85 maize grinding mill machines. The total productive time in one shift is 450 min. (7.5 h) and the total number of stations is 8. The operating time in each station varies from 20–90 min. Due to this, many station wait for the other stations to complete the operation. The time taken by each operator is different in the same station and the work load of each operator is different.

Table 1: *Time for Each Station in the Assembly Section.*

Elemental time for each station in the assembly section:

Station No.	Work Element	Elemental time		
		Manual (min)	Auto (min)	Walk and wait (min)
1.	Top & Bottom cover	240	_	10
2.	Cutter Shaft	90	-	4
3.	Cutter	300	-	10
4.	Iron Strip	35	-	5
5.	Stand	45	-	4
6.	Lower & Upper Lock	60	-	6
7.	Bearing Housing	30	-	3
8	Paint	10	50	5
9	Final fitment	45	-	10
10	Final inspection	15	-	4

Data Analysis

After studying the main operations and strategy of the company, the takt time for the assembly line has been calculated. Then the operations times of the various operations are noted. It is found that there is a large difference in the work content and time taken by each operator, and also a need for line balancing. The time details of each operator in assembly line were collected. Time of each station and operator is obtained using a stop watch. The details are shown in Table 1.

Takt Time Calculation

It is the ratio of the available production time to customer demand. It provides the heartbeat of a lean production system (Figure 1).

Available production time= 900 min

Customer demand= 2 maize grinding mill

Takt time= Available production time/Demand per shift

Takt time = 900 min./2 = 450 min / maize grinding mill

From the table following details are collected and analyzed Cycle time for the entire assembly is 495 min.

Total work content = 981 min.

Total number of operators= 18

Line Balance Efficiency

It is a means of measuring the degree of balance for each process time in flow line operation. It is the percentage of the available work station time that is used productively.

Efficiency, η = total work content / (No. of operators * Cycle time)

= 981/(18*495)*100

= 11.01%

Balance delay = (1-η0.1101)*100%

= (1–0.1101)*100

= 88.99%

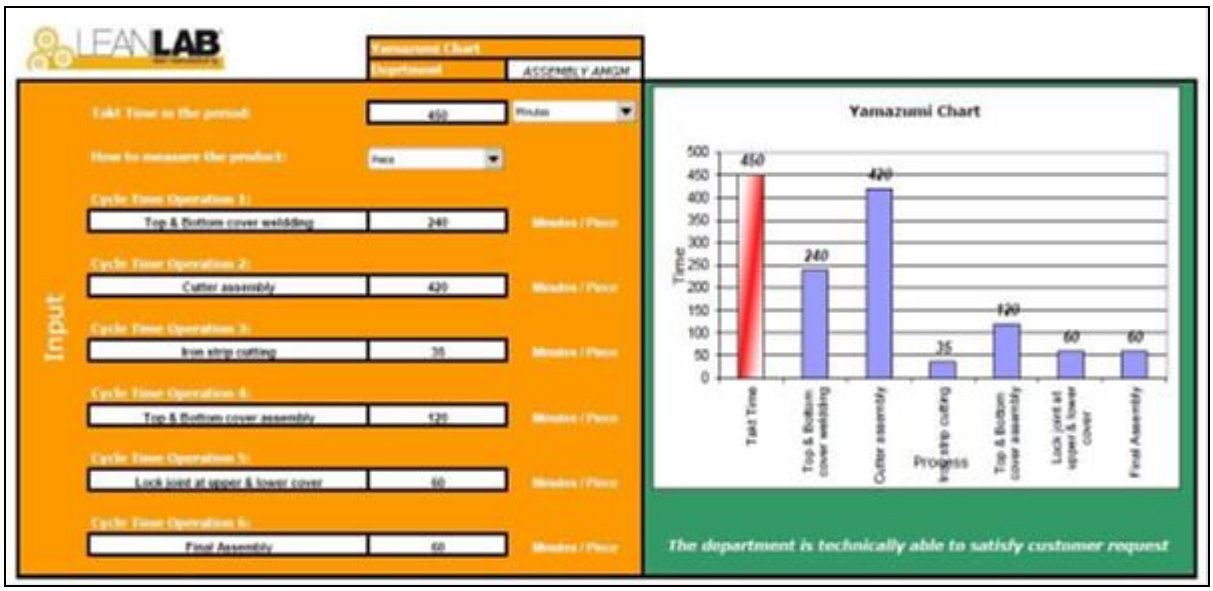

Fig. 1: *Takt Time by Yamazumi Chart.*

Value Stream Mapping

A value stream is all the actions (both value added and non-value added) currently required to bring a product through the main flows essential to every product (Figure 2).

- The production flow from the raw material into the arms of the customer.
- The design flow from concept to launch value stream mapping is a pencil and paper tool that to see and understand the flow of material and information, as a product makes its way through the value stream.
- Material and information flow pathways.
- Bottleneck conditions.
- WIP inventory
- Processing time and production lead times.

Assembly Plant Layout

Figure 3 displays the current layout of the assembly process for maize grinding mill. There are eighteen labours for the processes. From the observation, labours capability has

not been utilized effectively. This is because the process is designed without considering the lean manufacturing system which uses some of the tools in order to optimize a production line like value stream mapping, problem identification and takt time consideration. The current maize grinding mill assembly line layout designed to be in an L-shaped. It is design in AUTOCAD software.

5S Workplace Scan Checklist

Department: Maize Grinding Mill Assembly — Place an "x" in the appropriate box based on number of events observed

Date: Scored By:

			Number of Observations >>	0	1-2	3-4	5-6	>6
Sort		**Distinguish between what is needed and not needed**						
	1	Unneeded equipment, tools, furniture, etc. are present				x		
	2	Unneeded items are on walls, notice boards, etc				x		
	3	Items are present in walkways, stairways, corners, fire exits etc.					x	
	4	Unneeded inventory, supplies, parts, or materials are present					x	
	5	Safety hazards (water, oil, chemical, machines) exist			x			
			Subtotal >>	0	1	4	6	0
Set in Order		**A place for everything and everything in it's place**						
	1	Correct places for items are not obvious				x		
	2	Items are not in their correct places				x		
	3	Walkways, workstations, equipment locations are not indicated					x	
	4	Items are not put away immediately after use					x	
	5	Height and quantity limits are not obvious			x			
			Subtotal >>	0	1	4	6	0
Shine		**Cleaning, and looking for ways to keep it clean and organized**						
	1	Floors,walls stairs, and surfaces are free of dirt, oil, and grease				x		
	2	Equipment is not kept clean and free of dirt, oil, and grease				x		
	3	Cleaning materials are not easily accessible			x			
	4	Lines, labels, signs, etc are not clean and unbroken		x				
	5	Other cleaning problems of any kind are present			x			
			Subtotal >>	0	2	4	0	0
Standardize		**Maintain and monitor the first three categories**						
	1	Necessary information is not visible				x		
	2	All standards are not known and visible				x		
	3	Checklist don't exist for all cleaning and maintenance jobs					x	
	4	All quantities and limits are not easily recognizable					x	
	5	How many items can't be located in 30 seconds			x			
			Subtotal >>	0	1	4	6	0
Sustain		**Stick to the rules**						
	1	How many workers understand the 5s principals						x
	2	How many times last week was daily 5s not performed						x
	3	Number of times that personal belongings are not neatly stored					x	
	4	Number of times job aids are not available or up to date					x	
	5	Number of times last week daily 5s inspection were not performed			x			
			Subtotal >>	0	1	4	6	8
			Total >>	0	6	16	24	8
			Grand Total 5S Score	54				

Fig. 2: *Workplace Scan Checklist.*

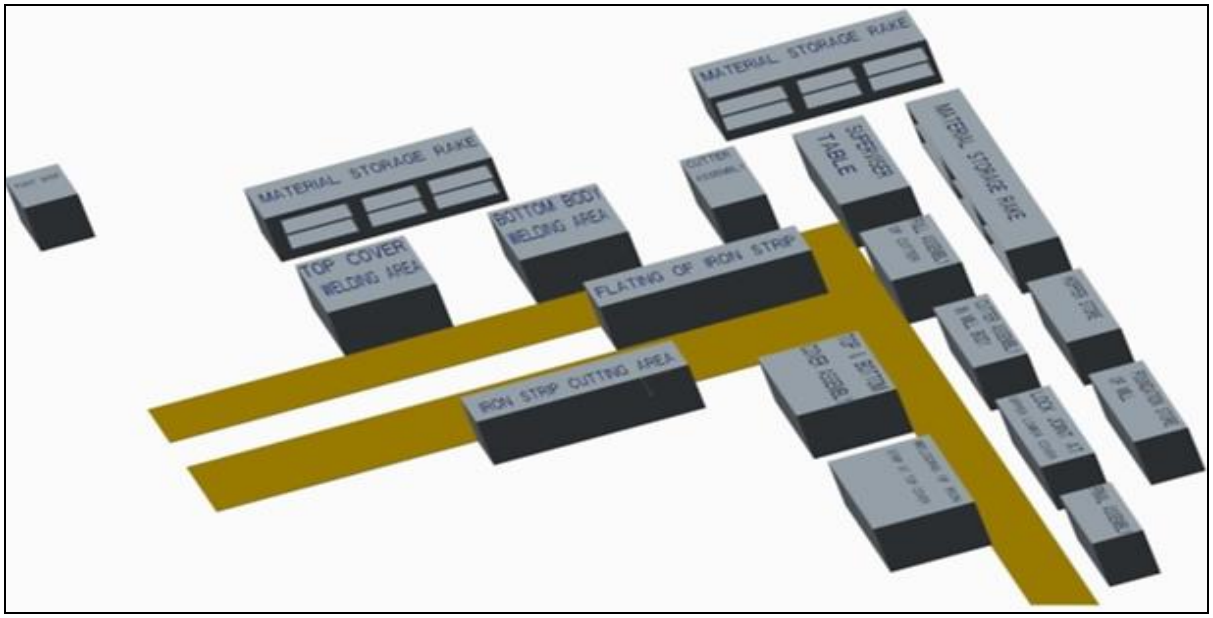

Fig. 3: *Current Maize Grinding Mill Assembly Line Plant Layout.*

CONCLUSIONS

The main operations and the strategy of the company and the takt time for the assembly line have been calculated. Then, the operation times of the various operations are noted. From the data obtained, it is analyzed that there is a large difference in the work content and the time taken by each operator. So, there is a need of line balancing. Initially, the cycle time of the total assembly was 450 min. and efficiency of the line was 11.01%. This needs to be improved further to attain operational takt time. For that, a detailed time study is conducted with the help of witness software and the application of the other lean tools, like standardize work. This helps to identify the waste time and eliminate it step by step, thereby reducing the cycle time by proper line balancing.

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