Evaluation and Implementation of Lean Manufacturing in Steering Knuckle Production Line

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***Abstract*: This paper describes the lead time reduction of steering knuckles. On observing the present system of steering knuckle production, the current lead time was calculated and found to be 20 minutes for producing one component simultaneously in CNC machines and their current production rate is 500 components per shift against the customer demand of 535 components per shift. A VSM is drawn to find out the value and non-value added activities involved in current production floor. Then, a Future Value Stream Map is developed to design a lean process flow through process improvements. To enhance the productivity and quality of products many firms are practicing the lean manufacturing concepts. Value Stream Mapping (VSM) is one of the lean tools to visualize the hidden waste and its sources. This project uses the VSM technique thereby helps the management to reduce the production lead time of steering knuckle and to fulfill the customer demands**.

INTRODUCTION

The Main motive of Lean Manufacturing is to reduce waste and highly responsive to customer demand while producing quality products in the most efficient and economical manner. A lean organization understands customer needs and focuses its key processes to continuously increase the production. The ultimate goal is to provide perfect value to the customers through a value create process that has zero waste. Eliminating waste along entire value streams, instead of at isolated points, creates processes that need less human effort, less space, less capital cost and less time to make products and services at far less costs and with much fewer defects. Lean can be applicable to any process not only to the manufacturing. Value
defined as a product or a service for which customer desires. In simple lean is Creating value with less work. Lean manufacturing also means increasing the speed by reducing the process time.Value-Stream mapping is a pencil and paper tool that helps you to see and understand the flow of materials and information as a product makes its way through the value stream. Value stream mapping can also be applied to the process industry as well as to the service sector. In this paper, VSM techniques is applied o he flow line manufacturing process in the context of production reduce the non value added activities, minimizing the takt time, maximizing machine, men and space utilization.

LITERATURE REVIEW

[1] Scherrer Rathje et al. (2009) identified the major criteria and conditions that lead to either lean success or failure. They found the sources to failure like the lack of senior management commitment, lack of interest and low acceptability of workers for changes.

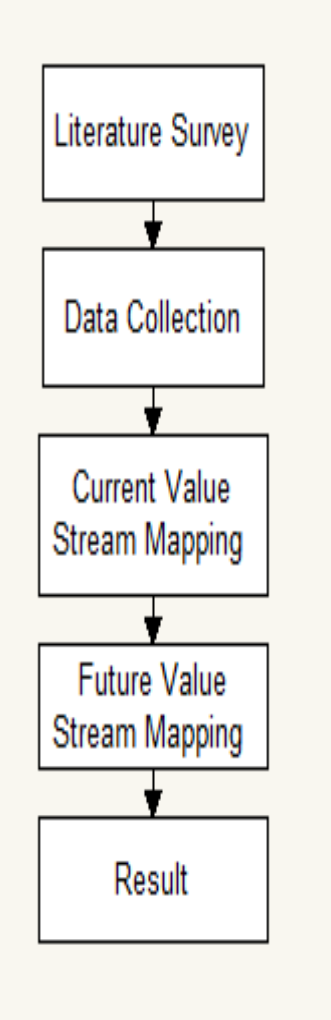
[2] McDonald et al (2010) explained wasteful steps that have to be eliminated and flow can be introduced in the remaining value-added processes. The concept of flow is to make parts ideally one piece at a time from raw materials to finished goods and to move them one by one to the next workstation with no waiting time in between.

[3] Gurumurthy and kodali (2011) presented simulation of models which have been modified by using Lean manufacturing principles and elements. The impact of implementation of lean manufacturing elements on the company‘s performance was also analyzed.

[4] . Dharun Lingam have done time and motion study of T-shirt manufacturing process and used two handed process chart to eliminated non-value added activities of workers thereby reducing the cycle time of the process.

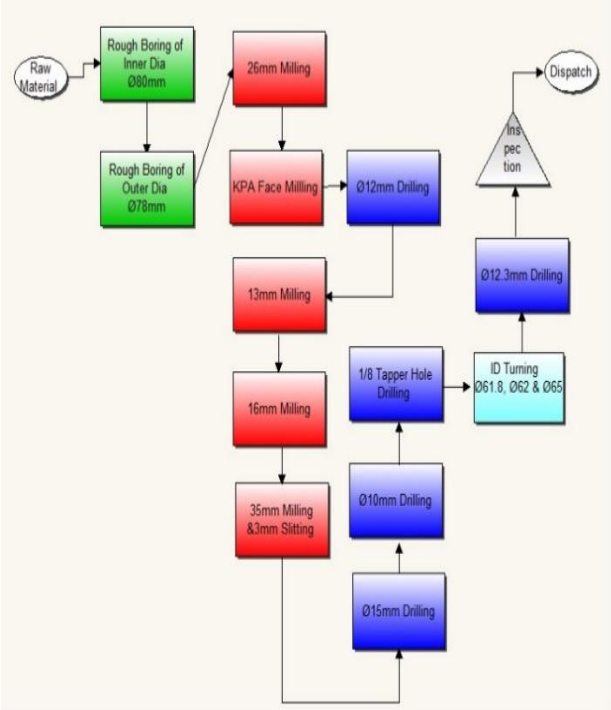
METHODOLOGY

Unbalanced machining line has been identified and the solution can be obtained by conducting work study on both men and machine and using the lean tools like line balancing etc. The brief methodology of our project is shown in Figure-1.



V. DATA COLLECTION

The process flow of steering knuckle is given in Figure-2

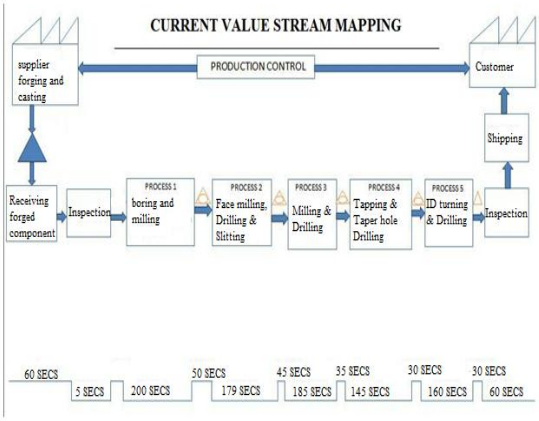


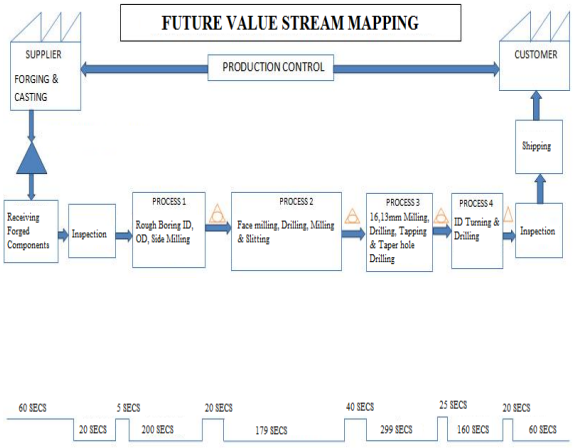
VII. CURRENT VALUE STREAM MAPPING:

The Firm under study employs 500 personnel including workers, supervisors, engineers and top management. It operates with 10000 square feet of space. The case study is dealt with steering knuckle manufacturing process and it is used in automobiles. The manufacturing of steering knuckle is flow line manufacturing process. All the data for current state map were collected with the consultation to workers, supervisors, engineers and top managers. The calculation of existing TAKT time is given below with the collected data from the firm's manager. The demand per day of steering knuckle is 550 numbers, current production capacity per day is 500numbers, the effective number of working days of the firm per month is 50.

TABLE I : DATA COLLECTION OF STEERING KNUCKLE PRODUCTION LINE

Process	Time (sec)	Contribution %	Value added (sec)	Non-value added (sec)
Receiving forged components	60	5.067		60
Delay	5	0.4		5
Rough boring of ID, OD, side milling	200	16.89	200	
Inspection of process 1	50	4.2		50
Face milling, drilling, milling & slitting	179	15.1	179	
Inspection of process 2	45	3.8		45
16, 13mm Milling & Ø12mm Drilling	185	15.6	185	
Inspection of process 3	35	2.95		35
Drilling, M10 tapping & Taper hole drilling	145	12.2	145	
Inspection of process 4	30	2.5		30
ID Turning & Ø12.3mm Drilling	160	13.5	160	
Inspection of process 5	30	2.5		30
Deburring & final inspection	60	5.067		60
Total time	1184	100%	869	315





VIII. FUTURE VALUE STREAM MAPPING

The firm's current production line has been analyzed by using value stream mapping tool of lean manufacturing. The value and non-value added activities of the production line were segregated and their considerations contribution are calculated. Here we suggest reducing the unnecessary inspections in the production line. It also suggested to combine the process 2&3in a single machine which will eliminate the need for the machine 3 and at the same time, the labour of process 3 can be used for inspecting the components coming out from process 1. By combining process 2&3, the inspection between 2 and 3 processes can be eliminated. The clamping of work pieces in all the process can be made by hydraulic grippers. It's our perception that by implementing these suggestions the firm may improve the production rate of steering knuckle to some extents to meet their customer demand

TABLE 2 : DATA COLLECTION OF STEERING KNUCKLE PRODUCTION LINE AFTER TIME CHANGE

Process	Time (sec)	Contribution %	Value added (sec)	Non-value added (sec)
Receiving forged components	60	5.514		60
Inspection	20	1.838		20
Delay	5	0.459		5
Rough boring of ID, OD, side milling	200	18.382	200	
Inspection of process 1	20	1.838		20
Face milling, drilling, milling & slitting	179	16.452	179	
Inspection of process 2	40	3.676		40
16, 13mm Milling & Ø12mm Drilling, Drilling, M10 tapping & Taper hole drilling	299	27.481	299	
Inspection of process 3	25	2.297		25
ID Turning & Ø12.3mm Drilling	160	14.705	160	
Inspection of process 4	20	1.838		20
Deburring & final inspection	60	5.514		60
Total time	1088	100%	838	250

RESULT AND DISCUSION

VSM	Total Manufacturing Time For Components(sec)	Value Added %	Non-Value Added %	No Of Components
Current State Map	1184	865	315	502
Future State Map	1088	838	250	535

In this paper increasing steering knuckle production by using lean manufacturing principles like value stream mapping, TAKT time, 5s methods. With this principles,we increase production value by decreasing machining time with same quality.

CONCLUSION

Line balancing will increase total number of components per day by 34 from present day production of 500 components. Time and motion study reduces 3 workers and improves each worker's utilization by 12%.

ACKNOWLEDGMENT

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