

Improving Productivity by Implementing Lean Manufacturing

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Abstract— The Lean manufacturing process refers to wipe out or minimize the seven deadly wastes by keeping the production flow maximized. It is a management tool for making a schematic production process with the lean initiatives through the recorded orderly information and investigation led further. It is a procedure for planning the enhancements suggested including the cost, outline, process improvements and so on. The target of this study is to create a value stream map for an automobile company of anti-vibrations solutions. This specific tool allows the organization to focus upon their current lead time, stock levels and cycle times to find out the ratio of value added process to the total lead time of the product line being investigated. The initial step is to generate a current state map to analyze the production flow and to evaluate the company's current cycle times, process interchanges, and equipment capacity of machine. The essential objective is to eliminate the wastes by first identifying the ones which do not add any value for the final product in the production.

Keywords— Lean manufacturing, value stream map, production cost, PPIC, seven deadly wastes, productivity, inventory control, process mapping.

INTRODUCTION

Lean manufacturing is a concept to abolish waste in production department of an Organization. The aim of manufacturing firm is to continually increase productivity by maximum utilization of their recourses in operations. The objective is customer satisfaction with absolute product, quantity, quality and value in lesser time. For getting the profitable production, a conspicuous approach is required to minimize the wastes in production. The seven wastes targeted by the Lean Manufacturing Philosophy are: motion, overproduction, over-processing, inventory, defects, waiting and transportation [1]. Part of lean manufacturing is checking the operations only for the parts, processes or components which add to price instead of value [2]. Carefully observed all the production step during manufacturing and add only those which improve the value of the product and other could be assigned to an outsourcing company so that the staff can focus only on the value-added operations of its core business. Taiichi Ohno and Shigeo Shingo framed a new, disciplined as well as a process-oriented system which is today called as "Toyota Production System (TPS)" or "Lean Manufacturing" [3]. They developed a system that upgrade the productivity at Toyota in between 1945 and 1970.

A stream map can be used to document on the current production lead time, inventory levels and cycle times in order to create a vision of an ideal value flow between the various departments and processes [4]. A Lean 3P (production, preparation, process) method was design a new endoscopy unit, which shows that 3P is an effective tool on developing the designs as per requirements of multiple stakeholders. The accuracy and efficiency process system can be improved at same time, by ensure lean production [5]. A Kanban system works effectively in multinational organization and to identify factors hindering small and medium enterprises (SME) from implementing Kanban [6]. A lean route map is implementing in organization for lean manufacturing system [7]. A green Manufacturing can be applied in all manufacturing sectors that minimize waste & pollution and ultimately enable the economic progress and contribute in conserving the resources [8]. The multi-dimensional concept, unavailability benchmark and uncertainty, which arises from the human judgments for the measurement of degree of leanness, is discussed by [9]. The objective of lean manufacturing is to manufacture a product exactly what the customer wants, it can be achieved by minimizing all non-value added activities in production [10].

The key principle of Lean is misspend "muda" the underlying driver of operational inefficiency [11]. Organizations should identify the waste from customer point of view and then regulate how to eliminate it. These waste increasing the product costs and adds no or just a zero value to manufacturing process [12]. The Process improvement is exact way for improvements of results as any organization.

An accurate inspection is required of work flows from one person or workstation to the next corresponding person or workstation. From a lean aspect, the first thing to create a value stream map following the indirect pathway of matter through the process [13].

PROBLEM IDENTIFICATION

The production management team of manufacturing firm is focusing on value-added activities to enhance their business productivity. Amid study it has been observed that they neglect the significance effect of non value added activities “wastes”. There is a remarkable statistical effect on production cost by evacuating the seven wastes through lean manufacturing. The mapping with all value-added activities can help in focusing on every root cause in an on-going process. This paper focused on the application of Lean manufacturing in process engineering and Global Production System (GPS) department for productivity improvement.

OBJECTIVES

The fundamental objective of the present work is to research the current situation of wastes elimination in the manufacturing firm and its vital role to reduce the production cost. It is required to create a value stream map in terms of value and non value activities, cycle time, marketing, PPIC (Product Planning & Inventory Control), manpower requirements, purchase process flow and other departments. The ultimate target is to improve productivity by lean manufacturing.

METHODOLOGY

Lean manufacturing is a philosophy to shorten the time line between customer requests and fulfillment by eliminating the wastes (Figure 1); these can be achieved by mapping the value and non value activities. The process mapping at different stages in the production department for AV1370 with all the process is shown in Figure 2. According to the customer requirements, the activities which are generally adding value are forging, rolling, quenching and which do not adds values are transportation, inspection, motion are depicted in a stream map (Figure 3) for part VSM_SPCL_M14X9.

BUSINESS AS USUAL



LEAN MANUFACTURING

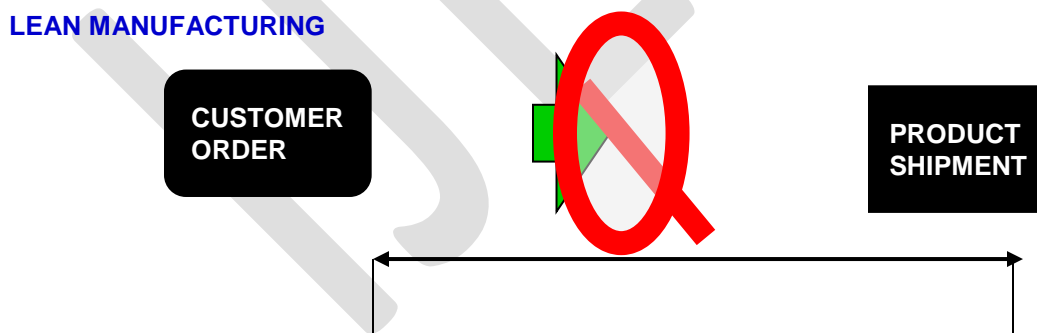


Figure 1: Reducing time by introducing lean manufacturing

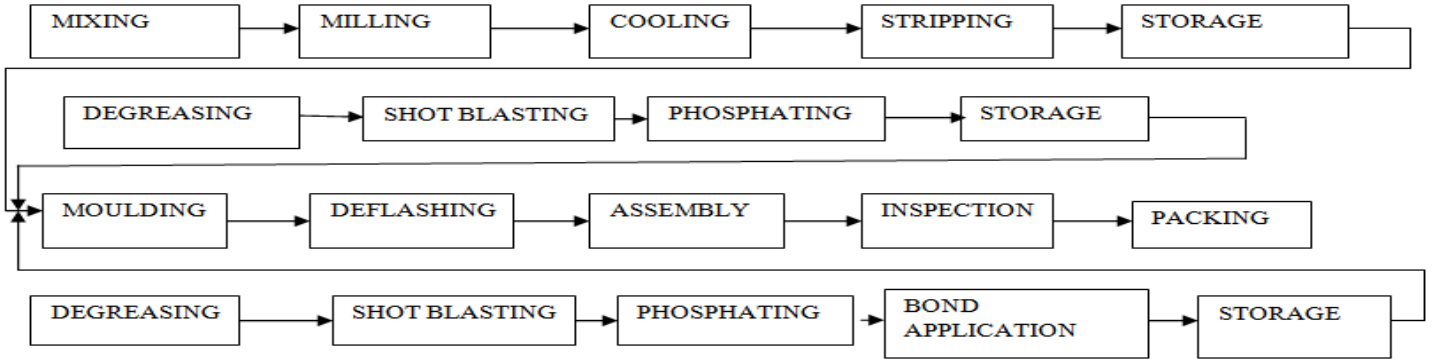


Figure 2: High level process mapping for AV 1730

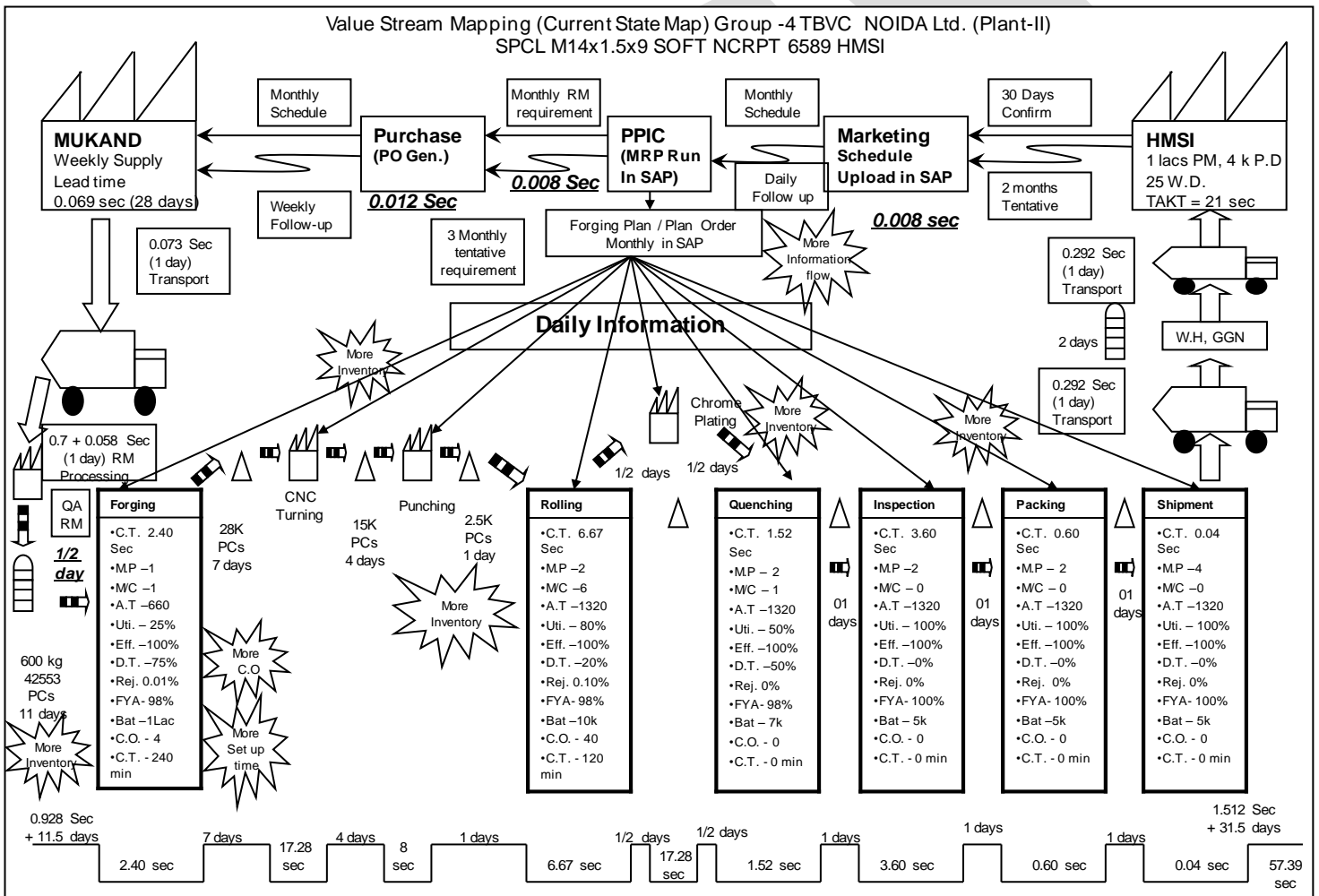


Figure 3: Value stream mapping for VSM_SPCL_M14X9

MARKETING PROCESS FLOW

Marketing process alludes the strategies or procedures that are created to ensure the customer has a positive and noteworthy experience when buying or utilizing the product or service. The marketing process flow is as shown in Figure 4 with the scheduling and planning as per customer requirements.

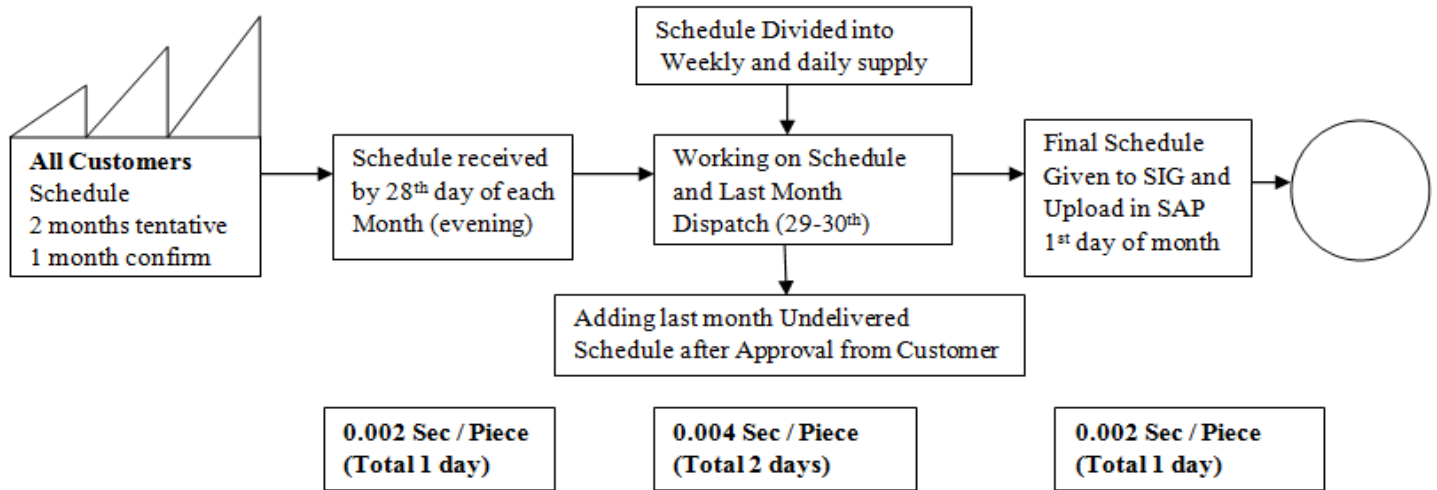


Figure4: Marketing process flow including scheduling and planning

PRODUCT PLANNING AND INVENTORY CONTROL

This procedure (Figure 5) indicates how the product planning flows along with inventory control process by keeping in mind to minimize the inventory cost and expand the use of assets, material and procedure.

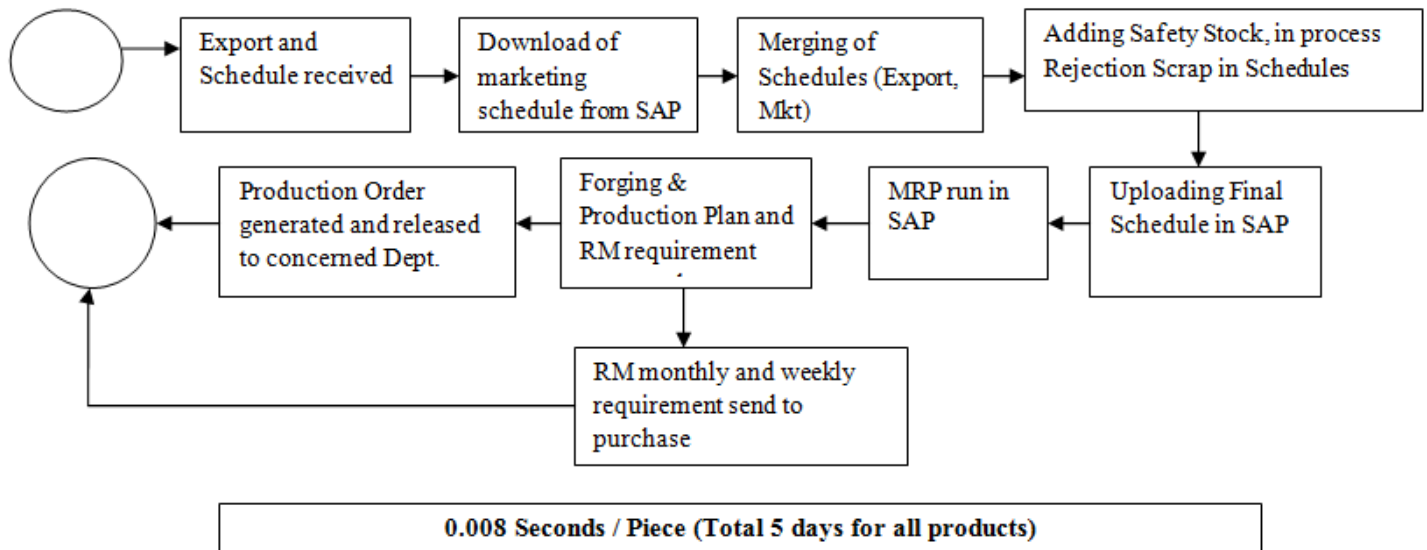


Figure5: Flow of Product Planning & Inventory Control

PURCHASE PROCESS FLOW

The method starts with a demand or prerequisites which could be for a physical part (inventory) or a service. It starts after receiving the requirements of raw materials from PPIC and later following the delivery of planned schedule and consignment flow as demonstrated in Figure 6.

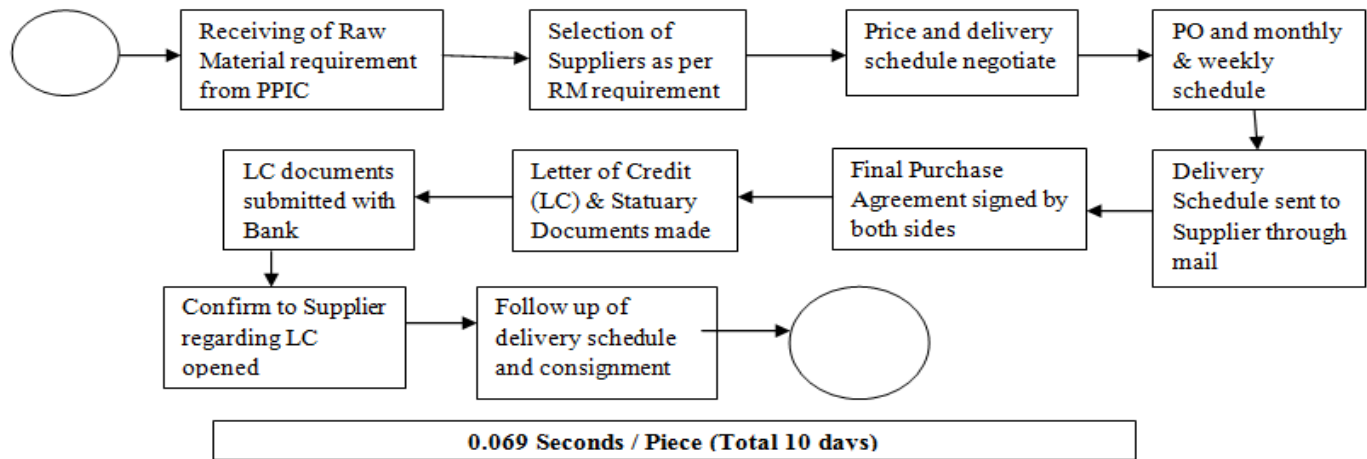


Figure6: Process flow of Purchasing Department

MARKETING AND PPIC PURCHASE

In this, the lead time is computed per piece of various activities such as Raw Material (RM), Marketing (MKT), PPIC Purchase involved as illustrated in Table 1.

Table1: Lead time calculation per piece for Purchase, Marketing, PPIC, RM

Activity	Total Days	Total Hours	Total Seconds	UOM	Wt _ MT Nov 10	Seconds / Wt(Kg)	Product Wt (Kg)	Lead Time (Seconds) per Pc
Marketing	4	92	331200	Sale Wt	608.100	0.54	0.0141	0.008
PPIC	5	115	414000	Final Deposit	771.011	0.54	0.0141	0.008
RM Purchase	10	230	828000	RM Purchase	974.163	0.85	0.0141	0.012
Supplier (RM)	28	644	2318400	RM Batch Process at Supplier End	475.000	4.88	0.0141	0.069
Transportation (RM Supplier)	1	23	82800	Supplier to RM Processing Vendor	16.000	5.18	0.0141	0.073
RM Processing Vendor (Option-I)	3	69	248400	RM Processing (Annealing + Drawn)	5.000	49.68	0.0141	0.700
RM Processing Vendor (Option-II)	0.5	11.5	41400	RM Processing (Drawn)	5.000	8.28	0.0141	0.117
Transportation (RM Processing Vendor)	0.5	11.5	41400	RM Processing Vendor to Factory	10.000	4.14	0.0141	0.058
Transportation (Factory to Warehouse)	1	23	82800	Factory to Warehouse	4.000	20.70	0.0141	0.292
Transportation (Warehouse to Customer)	1	23	82800	Warehouse to Customer	4.000	20.70	0.0141	0.292

RESULTS

In this section, the summary sheet of SPCL_M14X 1.5X 9.5 SOFT NCRPT 6589 is exhibited (Table 2) in which different activities are recorded with various departments. Amid study, the present value is noted down and target esteem which is to be accomplished is composed (Figure 7). The Target value is reduced as compared to present value. The most noteworthy decrease in target value can be seen in inventory days for computer numerical control (CNC) machine i.e. from 7 days to 1day which at last, profited in on-time delivery of the product. The production was increased along with the decrease in waiting time which is basically an elimination of one of the seven kinds of wastes. The production is increased along with the decrease in waiting time which is essentially an elimination of one of the seven kinds of wastes. The cost benefit analysis is carried out and number of resources is seen according to the prerequisite. The contribution of single project with total time is carried out. The total cost benefit is most extreme (INR 1,186,025) for manufacturing processes which are increasing the value to the product such as forging, punching, quenching, chrome plating and so forth (Figure 8). The base money saving advantage is accomplished by marketing department which is around INR 11,107. The benefit is seen for all the undersigned projects whether it will increase production or decrease cycle time, waiting time etc. So, overall value stream mapping is done which clearly depicts all the value-added and non-value added activities along with the individual cycle times so that benefits and maximum utilization of resources can be accomplished.

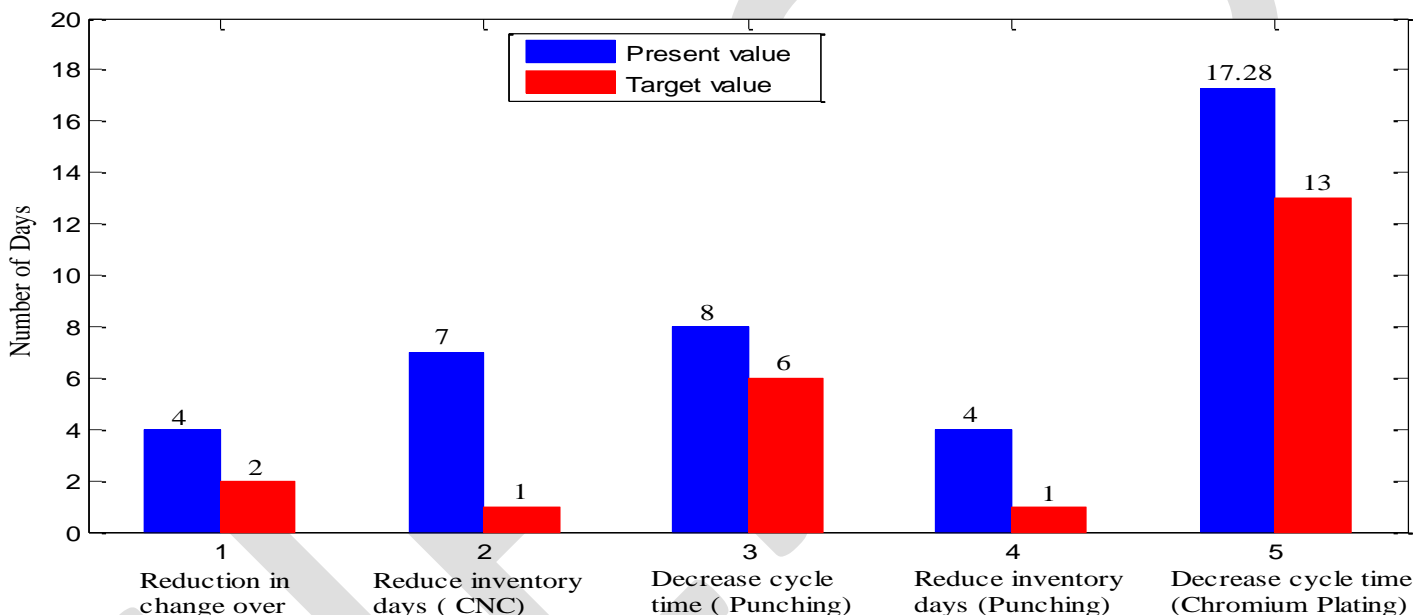


Figure7: Present & Target values comparison with different project activities

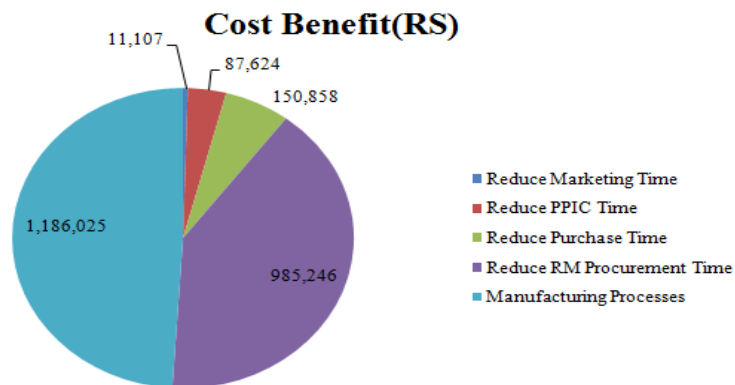


Figure8: Comparison of Cost benefits with the different departments of activities.

Table 2: Project Summary sheet including the benefits, project time, resources utilized

Sr. No.	Customer Criticality	Projects	Department	Type	Present Status	Target	Benefit	Cost Benefit	Project Time	Responsibility	No. of Resources	% of Total Time
1	9	Reduction of Down Time	Forging - 2D4B	Project	75%	53%	Increase Production	1,186,025	2 weeks	Forging	4	20%
2	9	Reduction in Change Over	Forging - 2D4B	KAIZEN	4	2	Saving of Set Up Hours		2 weeks	Forging	4	20%
3	8	Decrease Set Up Time	Forging - 2D4B	Project	240	180	More Production Hours		2 weeks	Forging and D & D	6	20%
4	9	Decrease Cycle Time	Vendor (CNC)	Project	17.28	11	Increase Production		2 weeks	D & D and SCM	3	20%
5	8	Reduce Inventory Days	Vendor (CNC)	KAIZEN	7	1	On-time Delivery		2 weeks	D & D and SCM	3	20%
6	9	Decrease Cycle Time	Vendor (Punching)	Project	8	6	Increase Production		2 weeks	D & D and SCM	3	20%
7	8	Reduce Inventory Days	Vendor (Punching)	KAIZEN	4	1	On-time Delivery		2 weeks	D & D and SCM	3	20%
8	9	Reduction in Change Over	Secondary - MTR 15	KAIZEN	40	20	Saving of Set Up Hours		2 weeks	Secondary	4	20%
9	8	Decrease Set Up Time	Secondary - MTR 15	Project	120	60	More Production Hours		2 weeks	Secondary and D & D	6	20%
10	8	Decrease Cycle Time	Secondary - MTR 15	Project	6.67	4	Increase Production		2 weeks	Secondary	4	20%
11	9	Decrease Cycle Time	Vendor (Chrome Plating)	Project	17.28	13	Increase Production		2 weeks	D & D and SCM	3	20%
12	8	Increase Batch Size	Quenching	KAIZEN	7000	20000	Decrease Waiting Time		2 weeks	Heat Treatment	2	20%
13	8	Decrease Cycle Time	Final Inspection	KAIZEN	3.6	2.5	Increase Production		2 weeks	Final Inspection	1	10%
14	8	Increase Batch Size	Final Inspection	KAIZEN	5000	20000	Decrease Waiting Time		2 weeks	Final Inspection	1	10%
15	8	Increase Batch Size	Packing	KAIZEN	5000	20000	Decrease Waiting Time		2 weeks	Packing Section	1	5%
16	3	Reduce Marketing Time	Marketing	Project	3 Days	2 days	Decrease Waiting Time	11,107	2 weeks	Marketing	3	20%
17	3	Reduce PPIC Time	PPIC	Project	4 Days	2 days	Decrease Waiting Time	87,624	2 weeks	PPIC	2	20%
18	3	Reduce Purchase Time	Purchase	Project	8 days	4 days	Decrease Waiting Time	150,858	2 weeks	Purchase	2	20%
19	3	Reduce RM Procurement Time	Purchase	Project	33 days	15 days	Decrease Waiting Time	985,246	2 weeks	Purchase	2	20%
Total Benefit								2,420,860				

CONCLUSION

Principle reason for this paper is to create a value stream map and recognize the contribution of waste in a specific undertaking which is influencing the lead time. After a specific assessment (Table 3), the production is increased due to decrease in downtime (forging) and decrease in cycle time (punching and chrome plating). The decrease in waiting time after the manufacturing operations is achieved with increase in batch size. The target value is diminished when compared with present value in inventory days for CNC machine which benefitted on-time delivery of the product (Figure 7). The total cost benefit is INR 1,186,025 for manufacturing processes.

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