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Application of Theory of Constraint for Reduction in Lead Time

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Abstract— *Theory of Constraint (TOC) philosophy developed by Eli Goldratt aims at improving the weakest links in a production chain as the performance of any production system is regulated by the bottleneck process. Hence focusing on eliminating these bottlenecks which also referred to as constraints can improve the performance of a system. Non-productive time and delivery time are the major factors that needs to be reduced in order to sustain in the fierce competition happening today. This paper addresses the problem of larger delivery time faced by a clamp manufacturing company situated at vasai that was resolved by implementing five steps methodology of Theory of Constraint which in turns resulted in 75 % of reduction in Lead time.*

Keywords— bottlenecks, Constraints, Lead time, Theory of constraint.

I. INTRODUCTION

Today's businesses are competing increasingly based on delivery time and product quality. Companies cannot survive in this competition if they fail to obtain competitive advantages by producing high quality products in shorter throughput time. Thus in order to fulfil customer's requirement within the shortest time, there is a need of utilizing the capacity of the production facilities to the fullest. The output of a system is a function of the entire system and not just of single process. When the system is seen as a whole, we understand that the output is a function of the weakest link of the system's process flow. This weakest link is nothing but the constraint. The aim of every organization is to achieve higher profits and each of them has at least one constraint that stands on the path, blocking it from reaching its final goal of improved profitability. Thus it is vital for any business to identify and manage constraints in order to achieve higher profits. Focusing on improving an entire system rather than improving bottleneck constraint, does not impact the overall system output. The consequences of viewing organizations from the constraints and non-constraints perspective are significant. Most organizations have to accomplish many things with limited resources. Thus in order to make real progress towards the goal, it is necessary to be focused on the constraint rather than entire system. Given this perspective, Theory of Constraint's 5-step process offers a systematic and focused approach that can be used by the organization to successfully pursue ongoing improvement. Theory of Constraints (TOC) consider that the performance of any production system is limited by the weakest link, or the bottleneck and focusing on eliminating these constraints leads to increase the efficiency of a system.

II. PROBLEM STATEMENT

Objective of this case study is to reduce lead time of the process by applying the constraint theory in order to find and eliminate the wastes in the process. Steel-Smith is a manufacturer of large variety of toggle clamps. The main issue at Steel-Smith is that the delivery time for the clamp is much more than their competitors as manufacturing time for each type of clamps is considerably large. Thus the possibility of loss of future orders is the major concern for them.

To overcome above mentioned problems Theory of Constrained Concepts was implemented which includes five steps methodology.

III. IMPLEMENTING TOC

Implementing TOC to the business organization is carried out using five focusing steps which provides a focus for a continuous improvement process are as follows:

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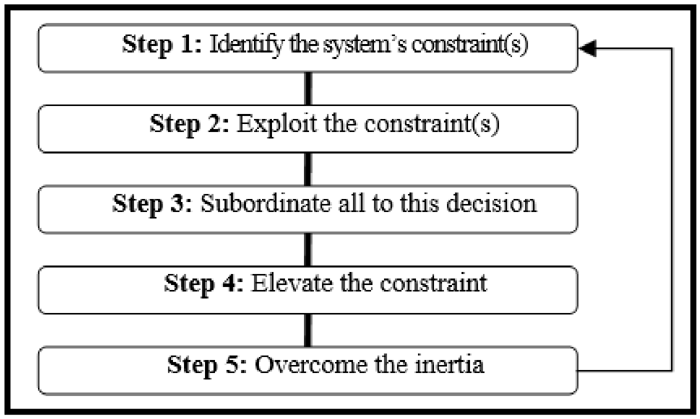

Fig. 1 Toc Methodology

The Product selected to analyze above mentioned problem is VTC-4595-UB as this product belongs to a product family having wide variety of sizes and also the demand of this product is very high. The Process Flow of the selected product is as shown in figure.

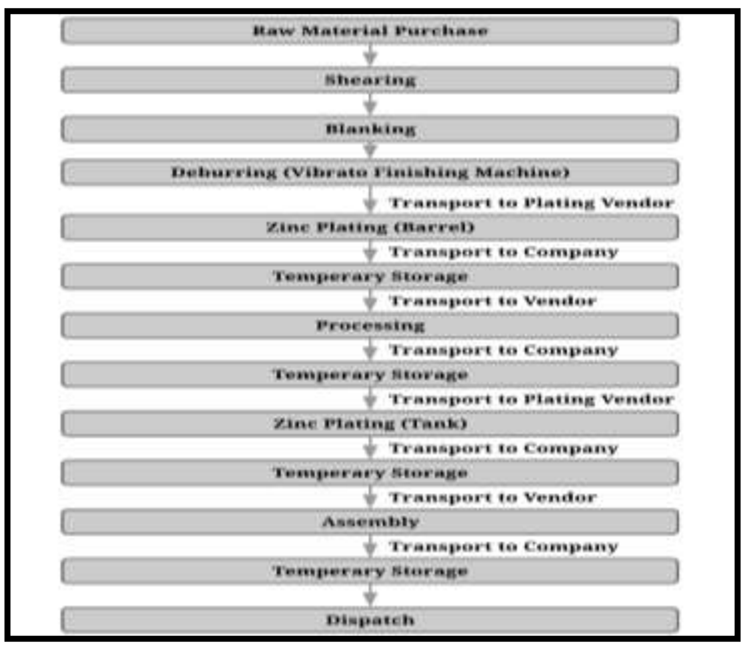

Fig. 2 Process Flow for VTC-4595-UB Clamp

3.1 Identify the constraint:

In order to identify the major obstacle in delivering the product within least possible time, a Current State Value Stream Map for processing the selected clamp have been prepared by analyzing the time required for each process required for manufacturing the selected clamp.

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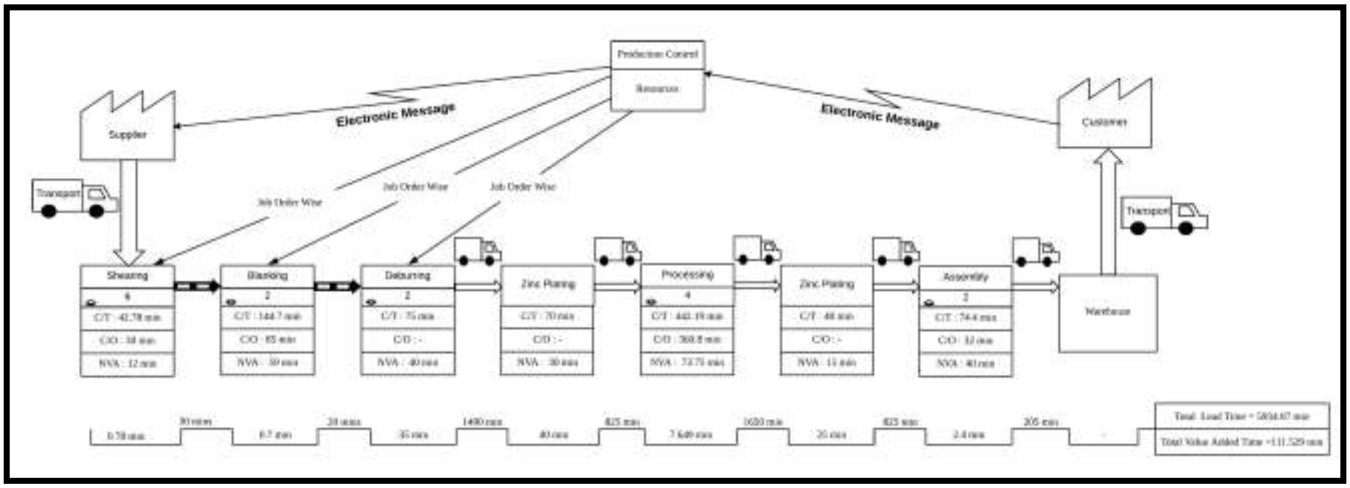

Fig. 3 Current State Value Stream Map

Table shows value added and non-value added time for various processes that are required for making the entire clamp.

Table 1
Value Added And Non Value Added Time (Current State)

Process	C/O time	Value Added Time	Non Value Added Time
Shearing	30 min	0.78 min	12 min
Blanking	85 min	0.7 min	59 min
Deburring	-	35 min	40 min
Waiting time before Plating	-	-	1440 min
Zinc Plating (Barrel)	-	40 min	30 min
Waiting time after Plating	-	-	600 min
Processing	360.8 min	7.649 min	73.75 min
Zinc Plating (Tank)	-	25 min	15 min
Assembly	32 min	2.4 min	40 min

From Current State Value Stream Map, it can be easily observed that the repeated transportation to plating plant and waiting time before and after plating process causing unnecessary delays in the process and thus plating process can be treated as bottleneck.

3.2 Exploit The Constraint

As the identified constraint lies outside of the company, few alternatives have been suggested so as to exploit the elements that makes plating process as bottleneck. First alternative suggested was to change the main vendor as he is located at Malad which is away from the company's current location thus causing repeated transportation to plating vendor and company which ultimately causes the delays in processing. Another alternative is to develop a new plating vendor as the workload at current plating vendor is more thus having more waiting time before and after the plating process.

3.3 Subordinate all to this decision

The suggested alternatives were presented in front of the management in order to make decision. Since the main vendor is with the company since its start, replacing this vendor was refused by the company management. Also the company tried a few plating vendors in nearby premises and found the quality of their plating inferior than the current one and thus eliminating this alternative.

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3.4 Elevate the Constraint

In order to eliminate this constraint, the new alternative of erecting in-house plating plant was studied for its feasibility as the number of clamps that requires plating is quite high. At first a Future State Value Stream Map is generated considering in-house plating process so as to analyze total lead time.

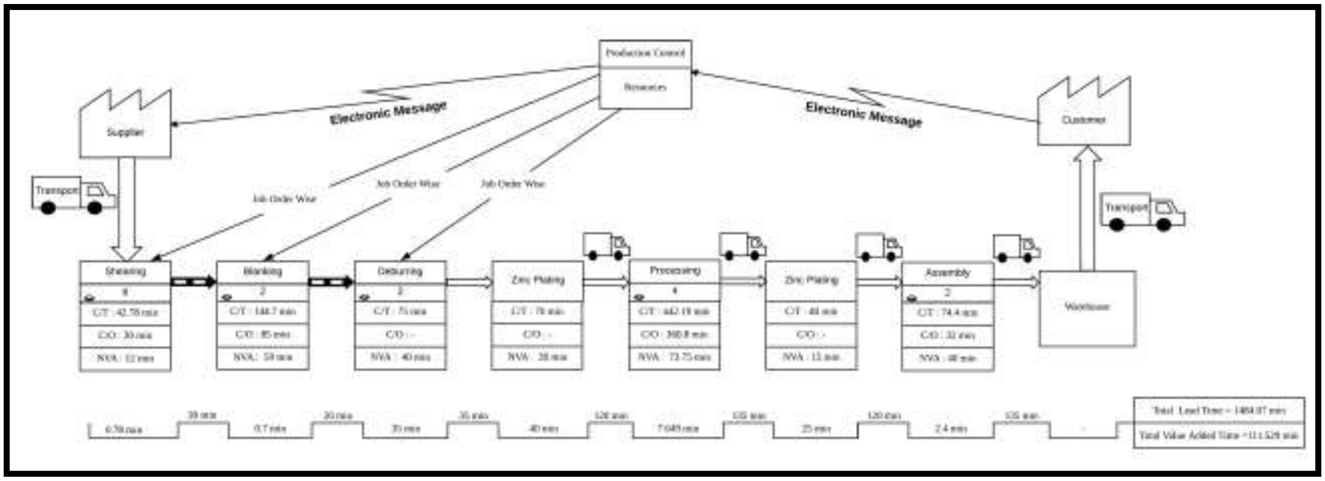

Fig. 4 Future State Value Stream Map

On comparing Future State Value Stream Map and Current State Value Stream Map, a considerable reduction in waiting time and manufacturing time can be seen.

Table 2
Plating plant erection cost

Parameter	Estimated Cost
Manually operated plating plant erection	Rs. 3,47,510/ -
Chemical Cost	Rs. 50,000/ -
Acid proof Tiling	Rs. 26,520/ -
Salary of new worker	Rs. 7200/ -
Electricity Bill	Rs. 4000/ -
Total Cost for in-house plating plant erection	Rs. 4,30,030 /-

This cost is compared with the plating cost of in current scenario so as to analyse whether this decision of erecting a new in-house power plant is profitable.

Table 3
Plating cost in current scenario

Parameter	Estimated Cost
Average Barrel Plating Charges per month	Rs. 59, 385/ -
Average Tank Plating Charges per month	Rs. 1, 03, 324/ -
Transportation to Plating Vendor	Rs. 331.16/ -
Salary of Driver	Rs. 16000/ -
Total Plating Cost	Rs. 1,79,040.14/ -

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IV. RESULTS AND DISCUSSION

By comparing Future State Value Stream Map with Current State Value Stream Map, following observations can be seen:

Table 4
Comparison between Current State and Future State Scenario

Parameter	Current State (Before implementing TOC)	Future State (After implementing TOC)
Waiting Time (min)	5045	595
Manufacturing Lead Time (min)	5934	1484

Total lead time can be reduced from 5934.07 minutes to 1484.07 minutes. Hence total 75 % reduction in lead time can be estimated by erecting in-house plating plant. Also we can find that the total cost of erecting the plant will be equivalent to the total cost of plating for almost 2.4 months. Thus we can conclude that the cost of erecting a new plant can be recovered in 2.4 months and the total savings of around Rs. 1, 67,840 / - per month can be done thereafter.

V. CONCLUSION

In this study, the problem faced by the toggle clamp manufacturing company has been analyzed using Theory of constraint approach. Value Stream Map for current state identified plating process as the bottleneck. To eliminate this bottleneck, erection of new plating plant is suggested as an alternative and after analyzing its feasibility it has been found that erection of new plant may yield following results:

1. Total lead time can be reduced from 5934.07 minutes to 1484.07 minutes. Hence total 75 % reduction in lead time can be obtained.
2. Total savings of around 1, 67,840 / - per month can be obtained after 2.4 months.

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