

Reducing Turn around Time in Laboratory using Value Stream Mapping

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Abstract

The effectiveness and efficiency of the production process flow can be achieved by reducing the waste identified in the process flow. Value Stream Mapping (VSM) is a basic method in lean manufacturing systems to identify and eliminate waste. The purpose of this research is to identify with the Value Stream Mapping (VSM) method on activities that provide value and eliminate other activities that do not provide value (waste) in one of the chemical testing laboratories. The research was conducted in several essential stages, namely the selection of product types to be observed, the making of the VSM of the current condition to the selected product, the analysis of VSM improvement of the current conditions, and then making the recommendation improvement. In this article, we can describe the current state of the process, and we can reduce Turn Around Time by suggesting the laboratory.

Keywords: Lean, VSM, Value Stream Mapping, Laboratory.

I. INTRODUCTION

Views of third party testing laboratory business nowadays already change, at the beginning only focus on result quality, including accuracy and precision, now also start to give the customer faster analysis time. This happens because customer requirements increase more fasten delivery time to make their production system more efficient. Moreover, third-party testing laboratories need to speed up the testing process to support the industry. Most prominent and successful companies use Lean Management to eliminate waste, cost-saving, and reduce delivery time [1].

Value Stream Mapping (VSM) is one of the tools for Lean Management. Value Stream Mapping (VSM) is a useful tool of Lean Manufacturing to reduce the wastage in any process by segregating Value Added (VA) and Non-Value Added (NVA) activities. Lean techniques are focus on reducing lead time and eliminating wastes in all kinds of forms [2]. This paper will focus on apply VSM from industry into the laboratory for increasing delivery time to customers.

II. BACKGROUND

A. Lean

Lean concepts are mostly evolved from Japanese industries, especially from Toyota. Lean manufacturing is considered to be a waste reduction technique as suggested by many authors, but in practice, lean manufacturing maximizes the value of the product through minimization of waste. Lean principles define the

value of the product/service as perceived by the customer and then making the flow in-line with the customer pull and striving for perfection through continuous improvement to eliminate waste by sorting out Value Added activity(VA) and Non- Value Added Activity(NVA). The sources for the NVA activity wastes are Transportation, Inventory, Motion Waiting, Overproduction, Over-processing, and Defects. The NVA activity waste is a vital hurdle for VA activity. Elimination of these wastes is achieved through the successful implementation of lean elements. [3]

Lean arise from the Toyota Production System. The variants of Lean Manufacturing, such as TQM, were initially founded in the Japanese automotive industry, but their evolution was mostly carried out in the West. Lean is a production practice that considers the expenditure of resources for any goal other than creating value for the end customer to be wasteful and thus a target for elimination; basically, more value with less work. Lean is a generic process management philosophy derived originally from the Toyota Production System (TPS). Womack et al. probably coined the term 'Lean.' in their book 'The Machine that Changed the World'. Some authors state that a definition of Lean includes both the people and the process components on the one hand and internal (related to the firm) and external (related to supplier and customer) components on the other hand. So, Lean is the production of goods using less of everything. In using Lean with your company, the goals would be to use less waste, less human effort, less manufacturing space, less investment in tools, and less engineering to develop a new product. Lean is renowned for its focus on reducing waste, which in turn improves overall customer value. [4]

Contemporarily, the implementation of Lean Manufacturing is methodically elaborated under the assumptions that waste elimination, which can be divided into nine categories (overproduction, motion, waiting, transportation, inventory, defects, over-processing, not-utilized talent, and unsafe or ergonomic working conditions), can be guaranteed by the application of a few organization techniques in a defined sequence. Among them, the following can be distinguished. [5]

- Workplace organization – 5S – sort, set in order, shine, standardize and sustain
- Visualization of work and its results
- Standardization
- Complex maintenance – TPM (Total Productive Maintenance)
- Fast refitting – SMED (Single Minute Exchange of Dies)



- Implementing quality in processes and continuous improvement.

B. Value Stream Mapping (VSM)

Value stream mapping is a method of lean manufacturing that uses symbols, metrics, and arrows to show and improve the flow of inventory and information required to produce a product or service which is delivered to a consumer. A value stream map is a visual representation that enables one to determine where the waste occurs. [6] Value Stream Mapping is a simple yet very effective method to gain a holistic overview of the conditions of the value streams within an organization. Based on the analysis of the current-condition, flow-oriented target value streams (target-conditions) are planned and implemented. [7]

VSM includes a set of all activates (value-added and non-value added) essential to bringing a product through the main flows, starting with raw material and ending with the customer. The main goal of VSM is to find different types of wastes and trying to eliminate them. The first step is to select a specific product or product family as the target for improvement. The second step is to develop a current state map that is mainly a snapshot, capturing how processes are currently being done. The third step is to draw the future state map that shows how the production process should be done after the wastes and inefficiencies have been removed. The future state map is created based on answering a collection of questions on topics relevant to efficiency and implementing technical issues related to lean techniques. Finally, the suggested map is applied as a basis for making essential changes to the system. [8]

VSM consists of two groups: Value Added (VA) Work and Non-Value Added (Work). Furthermore, VSM presents a chart-like mapping process from the start until the end of the product ready to deliver to the customer. Or it may use as future state visualization tools as we have seen in Figure 1. [9]

If we were successfully mapping our business process through VSM, we could see which part has a lot of waste time, and we can focus on improving on that part. From the customer point of view, they do not need the waste that we create in our business process. Toyota identified seven waste that we will identify in our business system are [16] :

1. Overproduction: Producing items for which there is no order.
2. Waiting Time: Employee standing about.
3. Unnecessary Transport: Moving materials optionally or long distances.
4. Over-processing: Using more steps to produce a product than required.
5. Excess Inventory: Holding unnecessary inventory between process steps.
6. Unnecessary Movement: Any waste motion by man or machine.
7. Defect: Making a defective product

VSM is a tool to increase a firm's efficiency and is typically used to identify the transformation of information

flow of raw material into the finished product or service of a value customers are willing to pay for. Benefits of VSM are that it enables visualization of the entire process, identifies flow decisions, links between operations, and provides an as-is and to-be state map. VSM tools and found that managers reported that VSM was beneficial in eliminating waste, focusing on crucial issues, and would continue to be important in the coming years. Applied VSM to complex production systems and conducted a case study to assess the validity of their proposed methodology and found that it is beneficial in handling complexity. VSM not only highlights process inefficiencies but also serves as an excellent form of guidance regarding improvement areas for organizations, hence providing efficient learning opportunities. There is an established practice to perform VSM of different processes to identify bottlenecks and points of improvement. Using VSM is recognized as a tool to improve the efficiency and effectiveness of manufacturing and logistical processes. However, reviewing more flexible and dynamic processes holds some novelty within the field of Advanced Manufacturing. [14]

III. CASE STUDY

Chemical Textile Laboratory is selected as a case study in this article. This company is one of the leading laboratories in the world. A multinational testing laboratory and we work in two-shift in 8 hours per shift, with total workers around 150 people. Moreover, one of the significant tests is the azo dyes test. After the simulation, we calculate in current state lead time in azo dye test is 7.4 hours. Furthermore, we also identified waste in the current state of working conditions are motion, inventory, waiting, and transportation.

IV. RESULT AND DISCUSSION

A. Current State of VSM

Value Stream Mappings are a planning and evaluation tool for improving the overall customer experience, is an attractive alternative in the arsenal of lean-manufacturing tools. VSM addresses the flow of materials and information needed to bring a product or service to a customer. It has many benefits, including [12]:

- Quick and easy to learn
- Identifies bottlenecks
- Identifies waste
- Inexpensive
- Focuses on no and low-cost improvements
- Uses a common language

As shown in figure 2 below, the current state of the azo dyes test works, and we can see also waste that generate in every step. In Table 1, we can see the waste that generates in every step of testing, but most waste is generated from the inventory. As we can see that most waste is in inventory due to still using the batch working procedure in the laboratory, and that is unavoidable. Due to the condition of the laboratory is not the same as the manufacturing that we can apply a flow-through system

using push or pull system, batch system still in use in most of the laboratory. Furthermore, from table 1, we can see inventory is the most factor generate waste in the azo dye test. The author with the team do brainstorming, analyze, and conclude that happen because of some condition like :

1. Most of the analyst in this laboratory is not doing one test only; they multi-tasking to do another test.
2. No dedicated equipment for a specific test, most of the equipment are sharing with another test.
3. Most of the chemical reagent is made freshly; the analyst needs to calculate no of test and made the fresh reagent based on the calculation.

From Table 1, we can analyze the bottleneck of azo dyes testing in chlorobenzene extraction. The author with the team analyzes that because we use one soxhlet extractor for one hot plate, that causes a long waiting time

in the testing process. It happens because process time in this step is around 30 minutes, so another sample in the batch needs to queue in this process.

B. Recommendation

To reduce TAT in the lab, the author recommends a dedicated person for the test; we need to calculate no test and workload. Also, add more tools in the bottleneck to avoid waiting when doing the test; in this case, it is soxhlet for extracting dyes using chlorobenzene. For saving space and minimize expend, the author suggests a modified soxhlet extractor from 1 soxhlet for each hotplate to 2 soxhlets for each hotplate to give maximum saving time for extracting dyes. By using this configuration, we try that can reduce inventory time from 8400 sec to 5471 sec. By calculation, it should be reduced two times, but due to longer setup time, it cannot reach reduce two times.

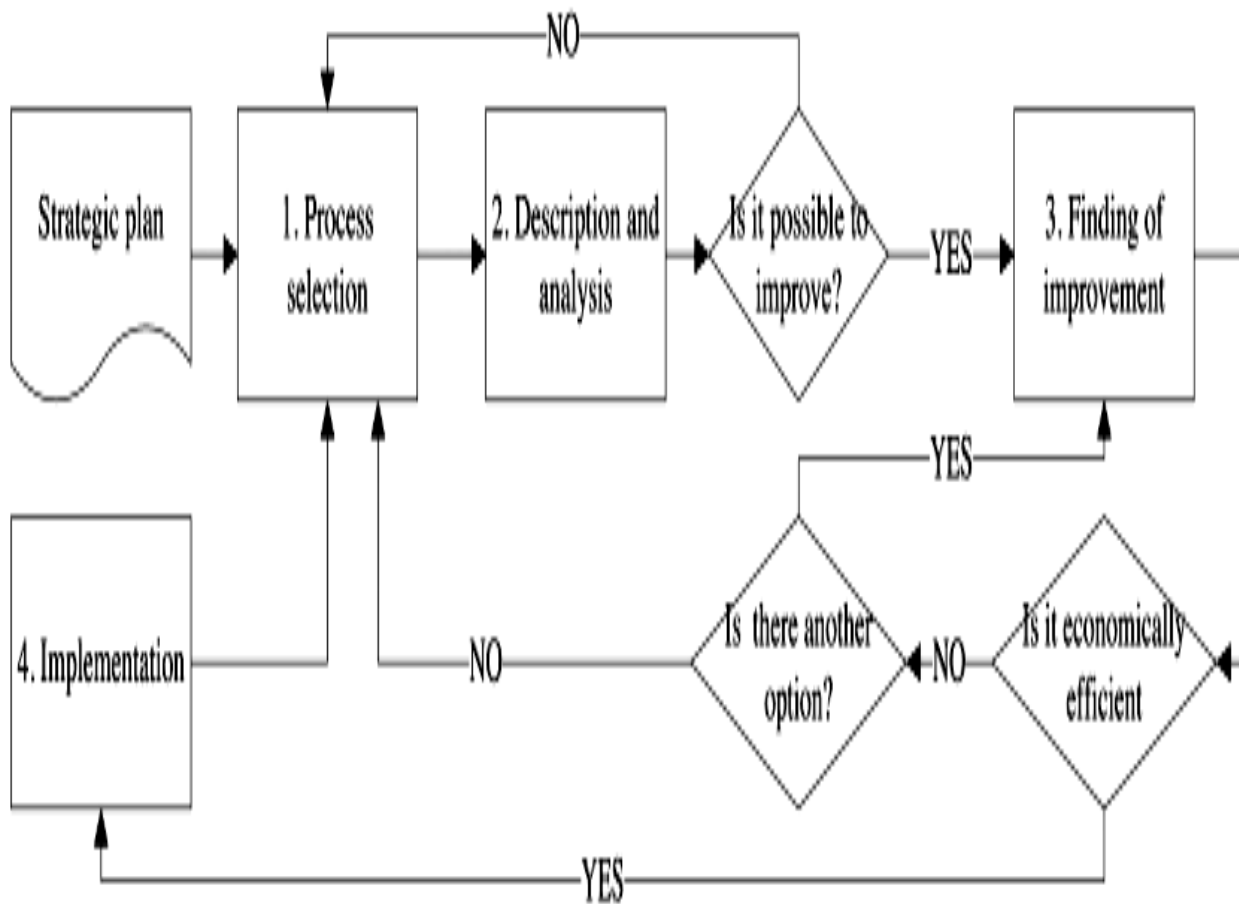


Figure 1. Process Improvement Procedure. [9]

Table 1. Waste Activity of Azo Dye Test

No	Work Station	Waste Activity	NVA Time (Sec)
1	Color Extraction	Transportation	8
	Cutting and Weighing		5
	Color Extraction		3
	Cool Down		5
	Shaking		5
	Rotary Evaporation		5
			Total
2	Review and Test Assign	Inventory	2100
	Cutting and Weighing		4200
	Color Extraction		8400
	Rotary Evaporation (1)		900
	Rotary Evaporation (2)		672
			Total
3	Cutting and Weighing	Motion	15
	Color Extraction		30
	Water Bath Extraction		150
	Cool Down		60
	Adding Reagent		10
	Shaking		30
	Rotary Evaporation		120
			Total
4	Transfer to Reaction Vial and Add Citric Buffer	Waiting	540
	Add Reduction Agent		90
	Adding Reagent		60
	Mark Up and Transfer to Vial Analysis		120
			Total

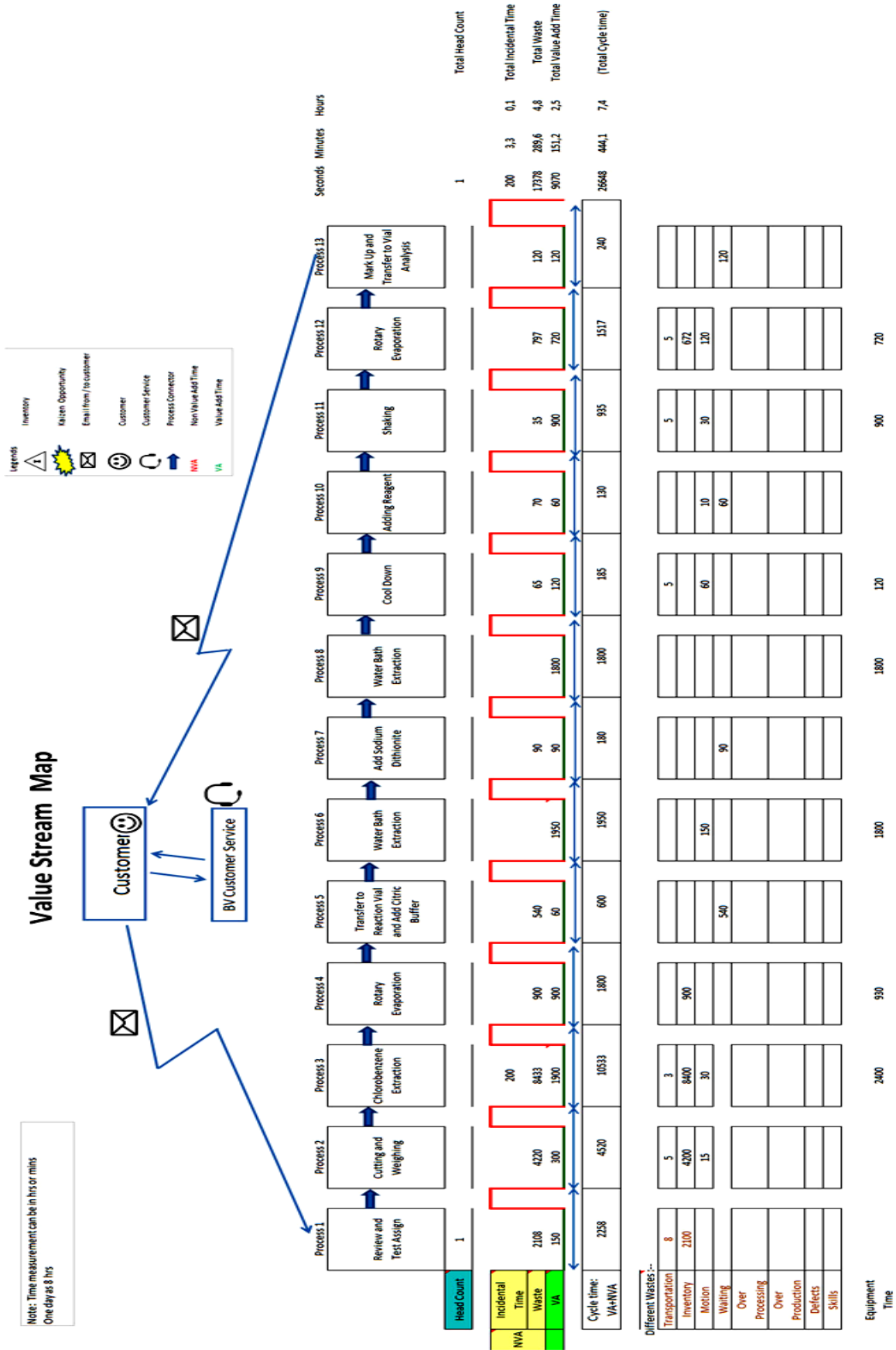


Figure 2. Current State of Azo Dye Test

V. CONCLUSION

The developed method of Value Stream Mapping is capable of systematically visualizing, analyzing, and optimizing multistage manufacturing processes from a quality assurance viewpoint. The procedure model consists of four consecutive phases: preparation, quality value stream analysis, quality value stream design, and implementation. The method enables the visualization of inspection processes, quality key indicators, and quality control loops within the process flow. [13]

Conducting a VSM in the chemical textile laboratory for azo dye test helps identify waste in every step and find which part of the step is generating the most bigger waste for the laboratory system. So the author can suggest management of the laboratory to improve the system of laboratory for the ultimate goal is decreasing the TAT of the testing laboratory.

Although VSM eventually reaches a point of diminishing returns, when applied with an attitude of "better beats best," laboratories can complete the process quickly and accurately. Value stream mapping can be hard work because it requires looking at a process as if every step is non-value-added and is costing the organization time and resources. With strong management support and individuals willing to make a change, small low-cost and no-cost steps in each part of the process will yield vast improvement to the overall value stream. [12]

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