

Value Chain Analysis using Value Stream Mapping: White Good Industry Application

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Abstract

The purpose of this paper is to introduce the value chain analysis methodology based on lean paradigm and value stream mapping tools to improve customer focus in the white good industry. 8 different value stream mapping tools are used to identify process wastes which are any activities that do not add value to final product in the process. VALue Stream Analysis Tool (VALSAT) was used as a rigorous analysis and decision-making tool in the value stream context. 3 value stream mapping tools which were selected by VALSAT were used in the case study to analyze value chain. According to the value chain analysis, different improvement ideas were proposed to eliminate non-value added activities. After implementing these ideas process improvements are visible in stocks which is by 49 % and in Lead Time which is 68%.

Keywords

Lean Management, Value Chain Analysis, Value Stream Analysis, Value Stream Map, White Good Industry

1. Introduction

Every organization is striving hard on getting more work done in less time and with greater ease. The fundamental aim of any organization has been to continuously minimize waste and maximize flow which would ultimately lead to customer satisfaction by providing right product at the right time in the right quantity and the right quality at a reasonable price [12]. This can be achieved greatly by adopting lean manufacturing system which is more than a cost reduction program. It aims at eliminating wastes which could be in the form of excess production and inventory, redundant movement of material, waiting and delays, over processing, excess worker motion, rework and corrections [4, 11].

Lean Manufacturing is a systematic approach to eliminate wastes and improve process. It is based on identifying and reducing waste coupled with continuous improvement. "Lean," is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination [11]. Working from the perspective of the customer who consumes a product or service, "value" is defined as any action or process that a customer would be willing to pay for. Basically, lean is centered on preserving value with less work [7]. Lean manufacturing is also popular by the name Just-In-Time Manufacturing developed by Toyota, the Japanese car manufacturer. The seven wastes originated in Japan, where waste is known as "muda". "The seven wastes" is a tool to further categorize "muda" and was originally developed by Toyota's Chief Engineer Taiichi Ohno as the core of the Toyota Production System, also known as Lean Manufacturing.

Seven wastes consist of Overproduction, defects, unnecessary inventory, inappropriate processing, excessive transportation, waiting, unnecessary motion [8, 12].

To reduce wastes and activities that add cost but no value are used Value Chain Analysis in Lean Thinking. "Value chain analysis" is the principal concept that is used to assess the competitive position of an organization and to understand the strategic influence of value activities and cost drivers [10]. Value chain represents the collection of activities performed by organization to design, produce, market, deliver and support its products. The purpose of this type of analysis is to enable organizations to accomplish their goal or mission through one of two strategies; (a) cost effectiveness (providing goods or services at a lower cost than the competition or superior goods or services at an equal cost). (b) Differentiation (providing goods or services that are valued for their uniqueness or fit a particular buyer's needs) the value chain breaks the organization into its relevant activities and provides a framework for understanding the behavior of cost. Decision makers may try to reduce these costs or identify possible sources of differentiation [1]. Value stream management requires understanding and managing the key elements of customer value and waste for the most important business processes. Techniques include mapping current state and the creation of a future state leading towards an ideal [10]. The value stream includes the value adding and non-value adding activities that are required to bring a product from raw material through delivery to the customer. Value stream mapping is an outline of a product's manufacturing life cycle that identifies each step throughout the production process [12]. Generally, supply chain and value stream are considered as same. The difference between a supply chain and a value stream is that a supply chain encompasses all of the activities of all the companies involved, whereas a value stream only refers to the specific activities which actually add value to the product or service [6].

In our value stream mapping, eight of the most useful tools which will be summarized were used. These methods derived from a variety of functional or academic disciplines have been assembled and have been applied under the term value stream mapping [9]. At this point it will be useful briefly to review the tools before providing a case example. The first tool, process activity mapping (PAM), aids in developing solutions to reduce waste. The second tool, supply chain response matrix (SCRM), aids in identifying the activities constraining the process so that these activities can be targeted for improvement. The third tool, production variety funnel (PRV), is similar to IVAT analysis and helps one understand how products are produced. The fourth tool, quality filter mapping, aids in identifying where quality problems occur. The fifth tool, demand amplification mapping (DAM), aids in analyzing the increase in demand variability as one travels up the supply chain, otherwise known as the bullwhip effect. The sixth tool, decision point analysis (DPA), aids in identifying "the point in the supply chain where actual demand pull gives way to forecast-driven push". The seventh tool, physical structure (PS), aids in developing a high-level understanding of the supply chain. Finally, the eighth tool, value adding time profile (VATP) is used for looking at time compression or mapping out where money is being wasted. The selection of "which tools to use in what circumstances is done using a simplified version of the value stream analysis tool (VALSAT)". Weightings are developed to determine the usefulness of each tool for identifying each waste. The weightings utilized in the analysis are dependent on the industry being considered, with some wastes being more relevant in some industries than on others. VALSAT tool is just a modification of Quality Function Deployment (QFD) whereby the WHATs represent the improvements required based on customer needs, and the HOWs represent possible techniques to achieve these improvements [2].

Through reading this document the reader should gain an understanding of the key value chain concepts, why and how the value chain and value chain analysis can be implemented in the white good industry. To clarify implementations of value chain, this work will present improved a production process of the white good industry in the manner that based on customer needs. The main improvement tool that was adopted in this document is VALSAT analysis.

2. Implementations Method

The present case study focuses on one of the production process (control panel printing) in the washing machine factory of BSH Home Appliances. It was identified as the key process that could potentially yield significant benefits if addressed. In this section, implementation method will be defined and in the next section organization will be introduced.

Implementation Method:

1. Identification of specific value stream to be reviewed: Specific value stream is determined according to the business objectives and customer expectation.
2. Identification of wastes that exist in value stream: Through a series of preliminary interviews with managers in the value stream, it is necessary to identify the various wastes that exist in the value stream that managers believe can and should be removed.

3. Selection of most appropriate value stream mapping tools by using VALSAT analysis: Defined wastes are recorded column 1 in the VALSAT in Figure 1.
 - 3.1. Ascertain individual importance weighting wastes: This is achieved most effectively by allocating a total of 35 points for the seven factors and asking the interviewee to apportion these on the basis of an importance rating between the factors, with the proviso that no one factor can attract more than ten points.
 - 3.2. Identify value stream mapping tools: The different approaches to identifying how these wastes can be mapped, is completed by the addition of the eight value stream mapping tools.
 - 3.3. Benchmark company in their sector: At this point it is informative to ask the firm or firms involved to identify for each of the eight wastes/structure the benchmark company in their sector.
 - 3.4. Identify correlation between wastes and tools: Correlation between tools and wastes are completed in figure 1. This is achieved by giving each of the different correlations given in Table 1 as a score. Thus, high (H) correlations are equivalent to nine points; medium (M) is three points; low (L) is a single point.
 - 3.5. Creation of total weight for each tool: Rating is given to each tool in terms of how useful it is in identifying the various wastes designated as of most importance by the organization or organizations. For each correlation that is defined 3.4, a total importance score is calculated. This is achieved by multiplying the weighting of each waste/structure by the correlations. Thus, referring to the correlations in Table 1, if the weighting for overproduction is six points the usefulness of the tools in addressing overproduction will be: 6 for process activity mapping (6 x 1) and it is similar for other mapping tool.
4. Analysis of specific value stream by using value stream mapping tools: Process is analyzed and important losses are revealed by using appropriate value stream mapping tools which are determined according to the VALSAT results.
5. Evaluation of analysis results: After the analysis, tangible results are evaluated and biggest wastes are defined.
6. Definition of improvement proposals: To eliminate wastes that are defined 3th step, improvement proposals are defined by using the analysis results.
7. Implementation of improvement: Improvement proposals that are determined in previous step are implemented.
8. Evaluation of results after implementation: Savings are defined after the implementation of proposals. Process is analyzed again by using same mapping tools and results are compared with the previous results.

Table 1: Mapping tools – 7 waste correlation table

		3.2 Value stream mapping tools							
1. Name of value stream		1	2	3	4	5	6	7	8
2. Wastes	3.1.Individual importance weighting seven wastes	3.4 Correlation matrix						3.3 Benchmark company in their sector	
		3.5 Total weight for each tool							

Losses	PAM	SCRM	PRV	OFM	DAM	DPA	PS	VATP
Overproduction	L	M		L	M	M		L
Waiting	H	H	L		M	M		M
Transportation	H						L	
Inappropriate processing	H		M	L		L		
Unnecessary inventory	M	H	M		H	M	L	H
Unnecessary motion	H	L						
Defects	L			H				

strategic management and corporate development. Support processes include management of supplier, information management, controlling / finance / accounting, human resources, technical and administrative infrastructure.

4. Implementation

Implementation will be realized according to the defined method and results will be discussed. In this section, we aimed to highlight evidence of improved financial performance of companies apparently adopting value chain principles. Also, purpose of implementation is lead time and stocks reduction in defined value stream.

1. Identification of specific value stream to be reviewed: One of the primary level processes (production) of washing machine factory was analyzed. Control panel printing process is selected because production costs are high and losses are much more compared to other production processes, thus improvement potential is high. Aim of this process is pad printing of the control panel and welding of display window to the control panel. 250 different variants are printed in this process; one of them is shown on figure 2.

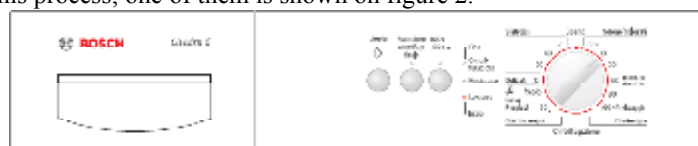


Figure 2: Control Panel

2. Identification of wastes that exist in value stream: Interviews were made with the managers and 16 losses of TPM were defined instead of 7 losses of Lean Management, because TPM (Total Productive Management) is implemented in the factory. 16 major losses of TPM are breakdown, set-up, cutting blade and job change, start-up, minor stoppages, speed losses, defects and reworks, shutdown losses, management losses, motion losses, line organization losses, distribution losses, measurement and adjustment losses, energy losses, die, jig and tool losses, yield losses.

3. Selection of most appropriate value stream mapping tools by using VALSAT analysis: We modified mapping tool – waste correlation matrix according to the 16 wastes. 80 points were allocated according to the costs of wastes. Set-up, shutdown and yield losses were the most serious wastes in the system. In order to understand this in more detail, and using the results of VALSAT analysis (Table 2). We created total weight for each tool as described in the section of implementation method (3.5) and decided to adopt 3 of the value stream mapping tools: “Process Activity Mapping”, “Supply Chain Response Matrix” and “Quality Filter Mapping” are selected for value chain analysis.

Table 2: Mapping tools – 16 waste correlation table

	C. TPM 16 Losses	D	PAM	SCRM	PRV	OFM	DAM	DPA	PS	VATP
Equipment	Breakdown	0,4	3	0	0	0	0	0	0	0
	Set-up	12,1	109	0	109	36	0	12	0	0
	Cutting blade change	0	0	0	0	0	0	0	0	0
	Start-up	0	0	0	0	0	0	0	0	0
	Minor stops	6	54	0	0	0	0	6	0	0
	Speed losses	8,8	9	0	0	0	0	9	0	0
	Defects & reworks	10,1	91	0	30	91	0	10	0	0
	Shutdown losses	12	0	108	12	0	36	36	0	12
Operation	Management losses	3	0	27	3	0	9	9	0	3
	Motion losses	1,9	17	2	0	0	0	0	0	0
	Line organization losses	9,6	0	87	10	0	29	29	0	10
	Distribution losses	2,3	21	0	0	0	0	0	2	0
	Adjustment losses	2	18	18	2	0	6	6	0	2
Mater	Energy losses	0	0	0	0	0	0	0	0	0
	Die, tool losses	0	0	0	0	0	0	0	0	0
	Yield losses	11,8	12	0	0	106	0	0	0	0
	TOTAL	80	334	242	167	234	80	117	2	27

4 & 5. Analysis of specific value stream by using value stream mapping tools & Evaluation of analysis results:

Process Activity Mapping (PAM): Based on time consideration used in PAM, obtained total time to produce 1 unit control panel is 760,9 minutes. From this total time, 122,25 minutes or 16,07 % were used for value adding activities. While non value adding activities spent 638,7 minutes or 83,93 % from total production time. The list of time allocation based on activity in control panel production process is given in Table 3. Biggest loss is store that is stock of final product. Delays are also important waste and include waiting during the set-up (105 min.). Besides, operation time consists of drying time (120 min.) of printing.

Supply Chain Response Matrix (SCRM): The illustration is made using 2 axis which are vertical and horizontal axis. The horizontal axis in SCRM represents cumulative lead time to plan and transfer product in supply chain. Vertical axis represents cumulative inventory in every stage of supply chain. Quality Filter Mapping: This map shows where three different types of quality defects occur in the value stream (Figure 4).

The first of these is product defects. Product defects are defined here as defects in goods produced that are not caught by in-line or end of line inspection and are therefore passed on to customers. The second type of quality defect is service defects that are problems given to a customer that are not directly related to the goods themselves, but due to the accompanying level of service. The third type of defect is internal scrap. Internal scrap refers to defects made within a company that have been caught by in-line or end of line inspection. Total quality defect ratio is 23.468 ppm. Most of the defecting parts are seen during the printing as scrap defects.

Table 3: Process activity mapping table

Activity	Time (min)	Proportion
Operation	122,25	16,07 %
Transportation	6	0,79 %
Control	1,5	0,20 %
Store	430	56,51 %
Delay	201,2	26,44 %

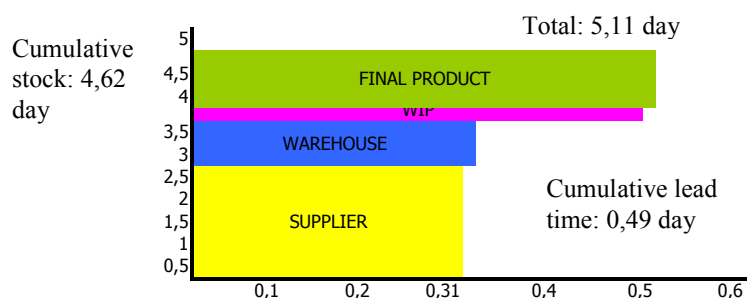


Figure 3: Supply chain response matrix

Table 4: Process activity mapping table (after)

Activity	Before Time (min)	After Time (min)	Improvement
Operation	122,25	2,75	97,75 %
Transportation	6	5	16,67 %
Control	1,5	1,5	0 %
Store	430	215	50 %
Delay	201,2	92,2	54,17 %
TOTAL	761	316	58 %

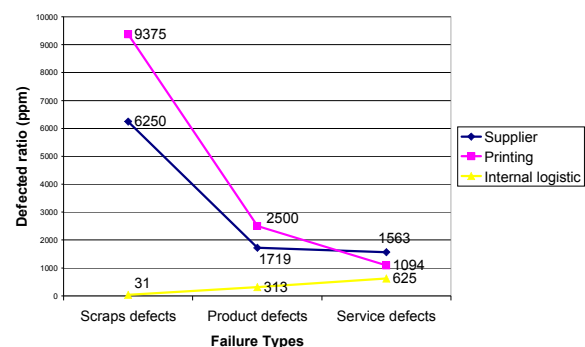


Figure 4: Quality Filter Mapping

6. Definition of improvement proposals: First proposal is change of manufacturing type of control panel printing. In the previous situation, functional manufacturing was implemented. In Functional Manufacturing similar machines were placed close together. Instead of functional manufacturing, cellular manufacturing was proposed. Cellular Manufacturing is based upon the principals of Group Technology, which seeks to take full advantage of the similarity between parts, through standardization and common processing.

The major advantage is that material flow is significantly improved, which reduces the distance traveled by materials, inventory and cumulative lead times. The transportation, delay and store losses and lead time that was

defined in the analysis of value stream, will decrease by implementing cellular manufacturing. Second proposal is given to reduce operation time. Drying of control panel printing takes nearly 2 hours. To reduce this waiting time and increase printing quality, usage of oven was proposed.

7. Implementation of improvement: To implement cellular manufacturing, products are separated in 3 groups according to the design and process similarities. 3 cells were created and machines were placed according to product groups. Oven was installed for 2 cells to decrease operation time of drying.

5. Results

After the implementation of proposals, we again analyzed improved control panel printing process by using 3 value stream mapping tools. (We excluded warehouse and supplier improvement in this study). According to the process activity mapping tool results, sum of the process time decreased from 761 min. to 316 min. and improved 58 %. (Other details are seen on table 4) When we analyzed improved process by using supply chain response matrix, we observed that lead time of the control panel printing process decreased from 228 min. to 73 min. and improved 68 %. Also stock level of the control panel printing decreased from 1444 min. to 710 min. and improved 49 %. On the other hand, quality defect ratio decreased from 23.468 ppm to 20.584 ppm and improved 12,2 %.

6. Conclusion

The value chain concept was first proposed by Porter as a business strategy tool. The focus of the work is on how activities create value for the customer and how managing activities can create competitive advantage. At the core of Porter's work is the idea of linkages, the boundary between one activity and the next. Porter considers that as a part of a business strategy, active management and improvement of these linkages is important as costs can be removed and partner synchronization improved. These both create the opportunity for competitive advantage. The value chain is the delivery mechanism in place to provide the value creating activities and create competitive advantage. It describes the companies involved and the style adopted for linking and coordinating activities in value creation [3]. The goal of this paper is implementation of value chain analysis in the BSH Home Appliances Company to create value for customer and gain competitive advantage. During the value chain analysis, VALSAT tool was adopted and 3 value stream mapping tool was selected and used for analysis. According to the results of these value stream mapping tools, different solutions were proposed and implemented. As a result of this study, process improvements are visible in stocks which is by 49 % and in Lead Time which is 68%. However, this improvement cannot be static and isolated; it is part of a continuous improvement strategy. Therefore, in future researches, this approach and method will be implemented for other departments in the factory and also in the supplier.

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