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Quality Control in Reducing Waste Defects in the Production Process Using the VSM Method in Electronics Component Manufacturing Company

Alfa Firdaus [1], Indra Almahdy [2], Atep Alfia Hidayat [3], Selamet Riadi [4], Dede Rukmayadi [5], Jakfat Haekal[6] and Tri widodo[7]

[1-4]Industrial Engineering department, Faculty of Engineering, Mercu Buana University

[5-6] Industrial Engineering department, Faculty of Engineering, Universitas Bhayangkara Jakarta Raya

[7] Industrial Engineering department, Faculty of Engineering, universitas muhammadiyah tangerang

Indonesia

ABSTRACT

If a company experiences a surge in the number of defects on the Frame Main Raph 322 production line, this is a serious problem that needs to be addressed immediately. The purpose of this study is to ensure the achievement of QTPP (Quality Target Product Profile), namely by knowing the high rate of defects, namely the average for 1 year is 2.5%, namely as many as 725 pcs/year, the largest defect is found, namely in the type of defect Unpos board assy of 39 %. In repairing and improving the production line, it is necessary to identify the causes of waste. Lean Six Sigma integration using the DMAIC, VSM and VALSAT methods is an effective way to determine waste and causes of waste. The analysis phase is carried out by knowing the VA and NVA values and implementing improvements based on FMEA.

Key Words: DMAIC, FMEA, Lean Six Sigma, VSM, VALSAT.

1. INTRODUCTION

In general, the goal of a manufacturing industry is to produce products economically to gain profit and deliver products perfectly on time. Additionally, the manufacturing industry aims for continuous and sustainable production processes to ensure the company's longevity. Nowadays, companies are also required to be more competitive to capture the market. One way to achieve this is by developing operational systems and processes through the elimination of unnecessary operational steps. Quality means meeting customer service expectations, making it a crucial element that must be fulfilled by the company. This can be used as a guideline that quality control is a significant part of the production process that impacts product quality, ensuring customer service satisfaction is achieved (Kholil et al., 2021). Quality control can be defined as the technical and managerial activities used to measure production quality characteristics, compare them with existing specifications, and take appropriate corrective actions if discrepancies are found between performance and standards. With quality control, deviations that occur can be minimized, and the production process can be directed toward achieving the desired goals (Haekal, 2022). A company can be considered high-quality if it has a good production system with a structured process. One approach to achieving this goal is the Lean Six Sigma approach. According to Haekal (2021), Lean Six Sigma can identify value stream processes and eliminate waste occurring throughout the value stream process. The company in this study is a high-quality electronic component manufacturer in Indonesia, producing a wide range of products including main frames, Carrey Cahill, Rasf, Mecha Presto Pronto, Costner, Cruise, Ink System, and Duplex. However, this study focuses on the Frame Main Raph 322 product, where each production is closely monitored for quality and on-time delivery as per customer requests.

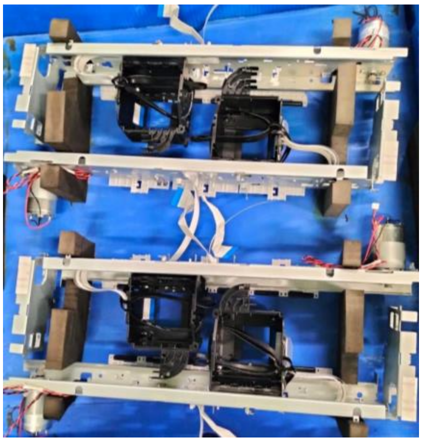

Figure 1 Frame Main Raph 322

The components involved in the internal parts of a printer include a motor switch process. The production flow starts from the Sub Assy Carriage - Sub Assy Grounding - Screwing - Insert Sheet FFC - Packing. The company always conducts inspections to reduce the occurrence of defective products; however, defects can still happen. Before shipment, Quality Control conducts a final inspection to ensure the produced products are suitable for supply. A common issue encountered during Quality Control inspections is finding abnormal products that do not meet the set standards, making them unprocessable and unshippable to suppliers. The quality target standard is zero defects. Such cases require re-checking and time to repair the abnormal products. Here is the data on defective products.

Table 1 Defect Table

No	Month	Production	Defect				%Defect
			Foreign Material	Unpos. Board Assy	Carriage Short mold	Grounding Broken	
1	January	21000	20	15	30	40	0.50%
2	February	22000	18	30	25	37	0.05%
3	March	23500	30	22	15	45	0.47%
4	April	22000	45	35	21	55	0.70%
5	May	21400	26	22	35	45	0.59%
6	June	22410	43	42	45	55	0.82%
7	July	21300	45	52	57	66	1.0%
8	August	21300	55	55	65	68	1.1%
9	September	22500	67	69	68	67	1.2%
10	October	23600	59	67	60	65	1.0%
11	November	25700	65	57	65	95	1.0%
12	December	19000	35	29	32	50	0.70%
Amount Total		265710	508	495	518	688	9.13%
Average		22142.5	42	41	43	57	0.73%

From Table 1, it can be seen that the production numbers from June to May did not meet the set targets. This clearly indicates quality issues in the production of the Frame Main Raph 322 that need to be analyzed further for improvement. The increasing number of defects can disrupt the interconnected production flow, leading to issues such as actual production not meeting targets, time required to fix defects, and delayed shipments to customers, among others. Therefore, factors contributing to the issues, such as human resources, machinery, materials, and others, must constantly be evaluated to determine whether they are still relevant to the current business conditions or if improvements are needed (Almahdy et al, 2021).

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2. RESEARCH METHODS

The research method for implementing Value Stream Mapping (VSM) in the manufacturing process of the Frame Main Raph 322 product involves several key steps aimed at identifying and eliminating waste, improving efficiency, and ensuring quality. The study is designed to analyze the current state of the production process, identify value-added (VA) and non-value-added (NVA) activities, and develop a future state map to guide improvements. The following steps outline the methodology used:

1. Defining the Scope and Objectives: The study begins by clearly defining the scope, focusing on the Frame Main Raph 322 production line. The objectives include reducing the defect rate, improving delivery times, and enhancing overall efficiency.
2. Data Collection: Data is collected on the current production process, including cycle times, inventory levels, defect rates, and lead times. This involves direct observations, interviews with staff, and reviewing production records.
3. Current State Mapping: A VSM is created to represent the current state of the production process. This map visualizes the flow of materials and information, highlighting areas where waste occurs, such as excess inventory, delays, or rework.
4. Analysis: The VSM is analyzed to differentiate between VA and NVA activities. Tools such as VALSAT (Value Stream Analysis Tool) are used to quantify waste and identify bottlenecks or inefficiencies.
5. Future State Mapping: Based on the analysis, a future state map is developed, proposing changes to eliminate waste and streamline the process. This includes redesigning workflows, reducing cycle times, and implementing quality control measures.
6. Implementation and Monitoring: The proposed changes are implemented on a pilot scale, with ongoing monitoring to assess their impact. Key performance indicators (KPIs) such as defect rates, lead times, and productivity levels are tracked.
7. Continuous Improvement: The process is continuously reviewed and refined based on feedback and performance data. This iterative approach ensures sustained improvements and alignment with the company's quality objectives.

Table 2 Research Step

Research Methodology Steps	Description
Defining Scope and Objectives	Focus on Frame Main Raph 322; set goals for improvement
Data Collection	Gather data on cycle times, inventory, defect rates
Current State Mapping	Create VSM to visualize current production process
Analysis	Identify VA/NVA activities; use VALSAT to quantify waste
Future State Mapping	Design improved processes; focus on efficiency
Implementation and Monitoring	Pilot changes; monitor KPIs to assess impact
Continuous Improvement	Ongoing review and refinement of processes

3. RESULTS AND DISCUSSION

3.1 Analysis Results of Work Time Measurement

In the activity of work time measurement (Time study), there are 5 time measurements, which are:

1. Cycle Time Measurement
2. Uniformity Test

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3. Data Sufficiency Test
4. Time Calculation
5. Standard Time Determination

The cycle time obtained is the time needed by the operator for Assy Carriage, Assy Grounding, Screwing, Insert sheet FFC, and Packing to complete their activities while working. In this study, the focus is on the process of Frame Main Raph 322, as this process has a high number of NG (Not Good) products, requiring continuous monitoring.

In processing the data for standard determination, control is carried out for each defect that occurs, which includes identifying the UCL (Upper Control Limit) and LCL (Lower Control Limit), allowing control over each defect.

Besides knowing the UCL and LCL, a uniformity test of the collected data was conducted. After calculating data uniformity and sufficiency, normal time calculation follows to determine the time required by the operator to complete the production of Frame Main Raph 322 per lot at each process stage.

Once the measured time data is considered uniform and sufficient, the final step is to determine the ST (Standard Time).

3.2 Analysis Results of Value Stream Mapping

In the production process of Frame Main Raph 322, there are 5 transitions from logistics to processing and from processing to shipping. Thus, the Current State Value Mapping contains information on cycle time and lead time on the production line to determine how much time is required to complete each task and how long it takes to complete one cycle of work. The cycle time shows that a total of 30 detik is needed to complete one unit of Frame Main Raph 322, while the lead time, which is measured during periods when the operator is idle and only waiting (delay), is 13 seconds.

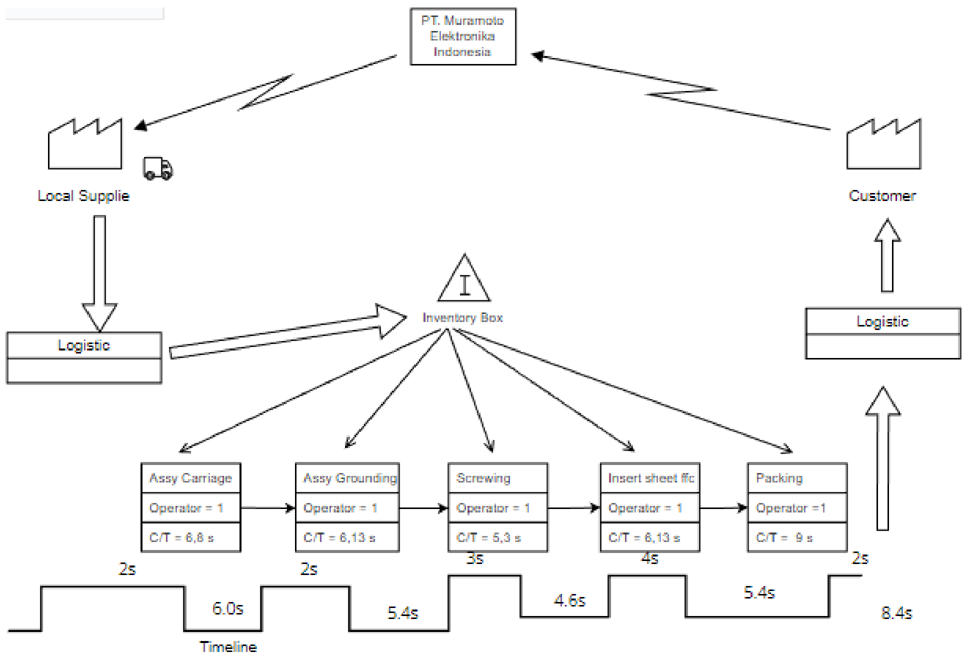

Figure 2 Current VSM

In the problem analysis results, the steps to prevent defect spikes before reaching the UCL and LCL and as control measures are outlined.

4W + 1H

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At this stage, the Fishbone diagram data analysis reveals 3 factors causing time wastage:

Machine

The torque machine occasionally malfunctions, causing the torque to be incorrect, which results in increased waiting time. Additionally, gaps in screwing at WIP are caused by the use of a manual conveyor.

Method

There is no checking activity before applying torque, which prevents damage prevention to the machine and increases waiting time.

Man

The use of a torque machine that is not centered in the proper position makes the screwing process ineffective and inefficient.

The following is a summary of the 4W + 1H (Why, When, Who, Where, and How) analysis, which can be seen in the table below.

Table 4 Action

	FACTOR	WHY	HOW	WHERE	WHO
DEFECT UNPOS BOARD ASSY	MACHINE	low torque pressure	Provided tools for torque pressure repair	RAPH 322 MAIN FRAME PRODUCTION LINE	Operator stage screwing
	MEHOD	Torque not checked before use	There must be standardization of torque usage		Operator stage screwing
	MAN	Torque use by the operator is not centered	Operators must master the use of torque		All Operator
	MACHINE	Gap Screw On WIP	Provide a manual conveyor for the WIP box		All Operator

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3.3 Future State Mapping

The following is a Future State Mapping to prevent and control time wastage based on the problems that occur.

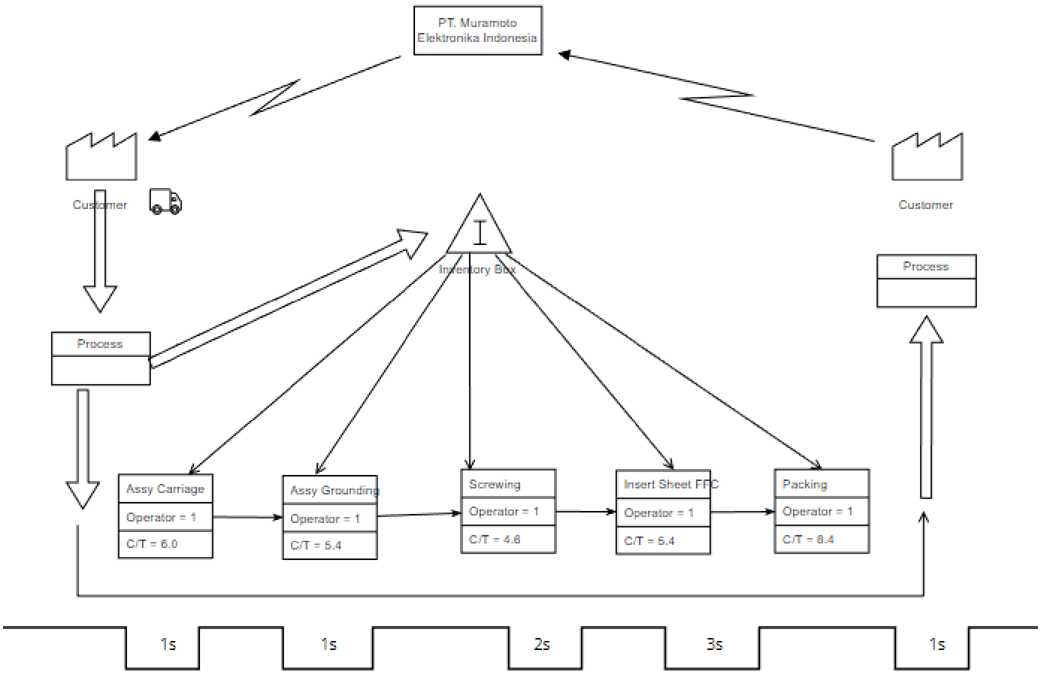

Figure 4 FVSM

4. CONCLUSION

Based on the research observation on waste reduction in the production line of Frame Main Raph 322, the following conclusions were drawn:

1. Based on the integration of Lean Six Sigma with the DMAIC, VSM, and VALSAT tools, the type of waste identified in the Frame Main Raph 322 production line is defects.
2. The analysis of the fishbone diagram revealed that the primary cause of waste is defects in the UNpositioned board assembly, which is attributed to low torque pressure. Additionally, it may also be caused by incorrect material size (screws), misalignment of screws with the hook carriage holes, or operator errors during assembly.
3. The efforts made to minimize waste in the Frame Main Raph 322 production line are as follows: a. To reduce waste related to positioned board assembly, it is proposed to implement FMEA with priority given to the failure factors with the highest RPN value of 180. This involves daily checks of torque pressure using a torque wrench as part of a calibration process to ensure the torque pressure used meets the established tolerance standards, thus preventing unpositioned screws. b. As a result, the defect rate in the internal process has decreased, leading to improved quality.

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