Six Sigma and FMEA Methods for Cause Analysis of the Defects in PT.X

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(artikel diterima: 14-07-2024, artikel disetujui: 30-08-2024)

Abstract
The manufacturing sector is currently competing against each other to always get market share. In achieving the vision and mission, the company must use one's strength to increase production and product quality. PT. X is a manufacturing company that manufactures piano musical instruments that continually do improve to increase quality to meet customer needs. This research used the Six Sigma and FMEA methods to minimize defects that occur. The results of calculations obtained Upright Piano (UP) PM / PW which has the highest reject value. The average value of DPMO for 8 months was 16294.57, and the sigma value was 3.62. The results of identifying the type of defect that is often the cause of reject cabinet using a Pareto diagram is the muke permukaan with a percentage of 24.03%. The dominant cause of the defect occurs because during the sanding process the position of the Ategi is tilted when at the edge and the operator's ability is not evenly distributed. Improvement that can be given during the sanding process Ategi's position tilted when at the edge of the position Ategi must be flat when at the edge of the cabinet and the balance when making the sanding process must be maintained properly. Improvement for the ability of operators that have not been evenly distributed, namely conducting training on basic skills to all operators who have worked for a long time, implementing the OJT (On the Job Training) program during probation, and sharing knowledge.

***Keywords**: Quality, Defect, Upright Piano (UP) PM/PW, Man Factor*

1. INTRODUCTION

PT. X is a company that manufactures piano musical instruments. The pianos are Grand Piano (GP) and Upright Piano (UP) with many variations of models, and there are several piano colors namely Polished Ebony (PE), Polished Mahogany (PM), Polished Walnut (PW), and Polished White (PWH).

In this study, the object of research focuses on the Upright Piano (UP) cabinet. It can be seen in Figure 1. which illustrates the number of cabinet rejects. The data from historical in check buffing panels UP in the last 8 months.

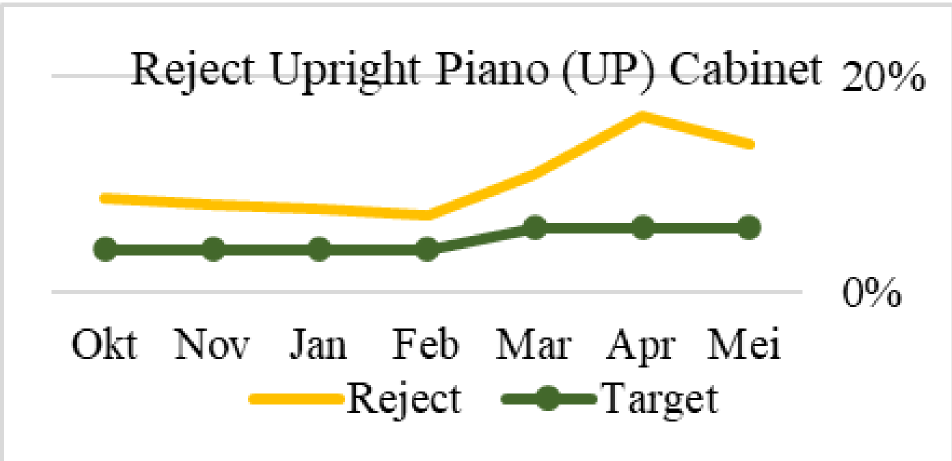

Figure 1. Upright Piano (UP) Reject Cabinet

Based on Figure 1. it can be seen that the rejection in the Upright Piano (UP) cabinet always exceeds the company's target which causes delays in output targets, obstruct further processes, and can certainly harm the

Based on Figure 1. it can be seen that the rejection in the Upright Piano (UP) cabinet always exceeds the company's target which causes delays in output targets, obstruct further processes, and can certainly harm the company. Therefore, action is needed to reduce the rejection of Upright Piano (UP) cabinets.

2. METHOD

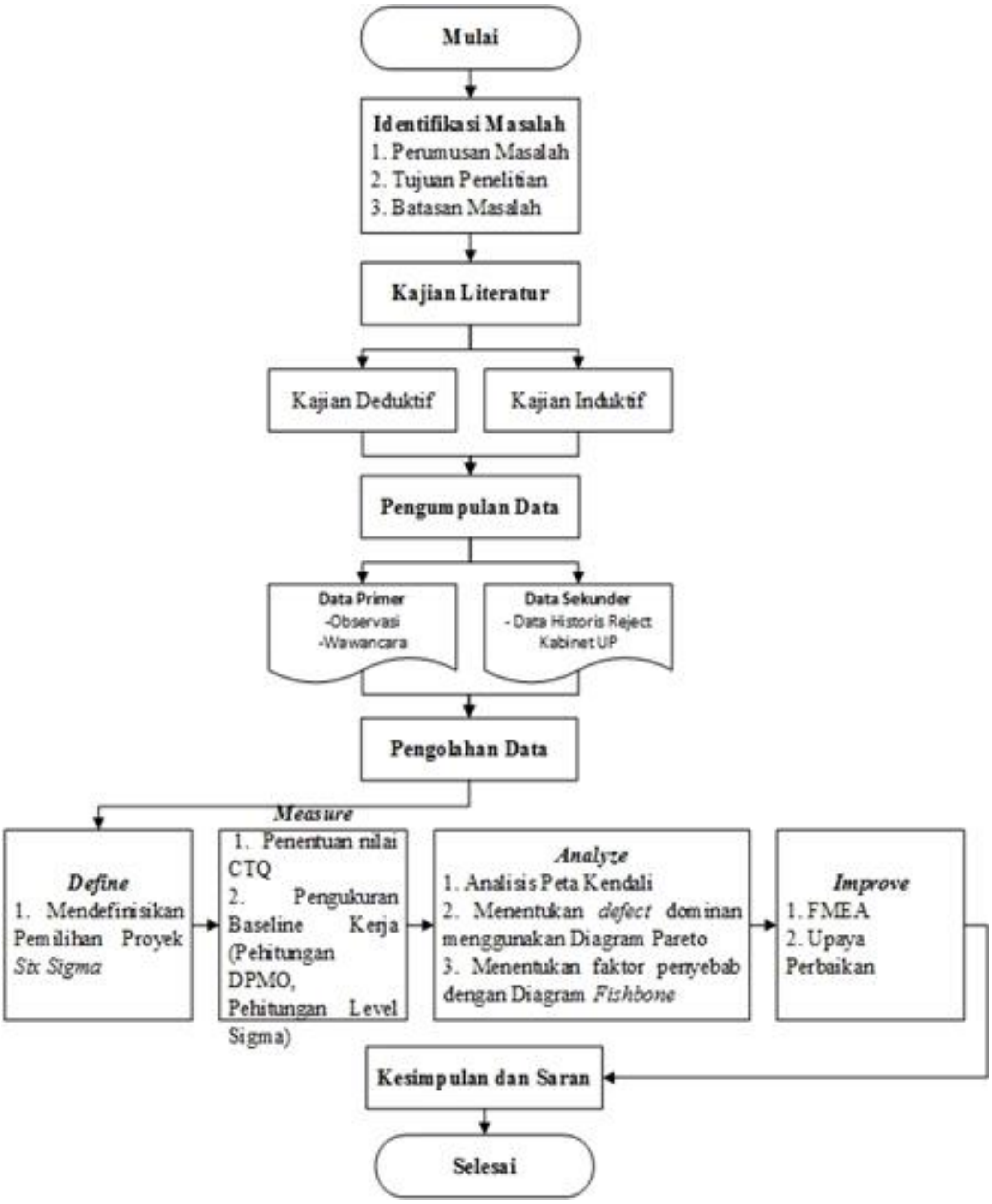

Figure 2. Research Flow

This research was conducted to determine the causes of defects that appear on Upright Pianos (UP) at PT.X. Observations were made at the Painting Department. This study uses primary data and secondary data obtained from field observations, interviews, and data from the company.

In this study, the methods used are Six Sigma (DMAIC) and Failure Mode and Effect Analysis (FMEA). Six Sigma is used to anticipate defects by using measured and structured steps, namely by using DMAIC and FMEA to know the value of the RPN (Risk Number Priority) or determine the priority of improvements to be done and determine remedial efforts in accordance with the problems that occur. Following the flow of research in this study.

3. RESULT AND DISCUSSION

3.1 Define

3.1.1. Defining Selection of Six Sigma Projects

The definition of Six Sigma project selection is done to better understand and know the general problems that occur at PT.X. The problem that occurred was the rejection of the Upright Piano (UP) PM/PW cabinet which resulted in a high % reject rate compared to the PE & PWH color.

3.2 Measure

3.2.1. Determination of Critical to Quality (CTQ) Value

The research identified 16 types of CTQ (Critical to Quality) that occur and which can affect the quality of the Upright Piano PM / PW cabinet, namely Muke Permukaan, Muke Edge, Dekok, Gelt, Kotor, Pinhole, Pecah, Obake, Muke Mentory, Mata Ikan (MI), Sambungan, No Good Logo (NG Logo), No Good Putih (NG Putih), Mentory Bolong, Cat Tipis, and Cloudy.

3.2.2. Performance Baseline Measurement

The average value of DPMO is 16294.57 which can be interpreted that in a million opportunities there will be as many as 16294.57 cabinet defects from the number of cabinets entering the production process and the average sigma value (σ) is 3.65. With this sigma level, the company is at the industry level in Indonesia and the USA. However, as an export-oriented company and a Japanese company, PT. X needs to improve its capabilities to 6 sigmas as an advanced industry.

3.2.3. Control Chart Analysis

Control chart calculation to determine the value of the upper limit (UC), the lower limit (LCL), and the center limit (CL).

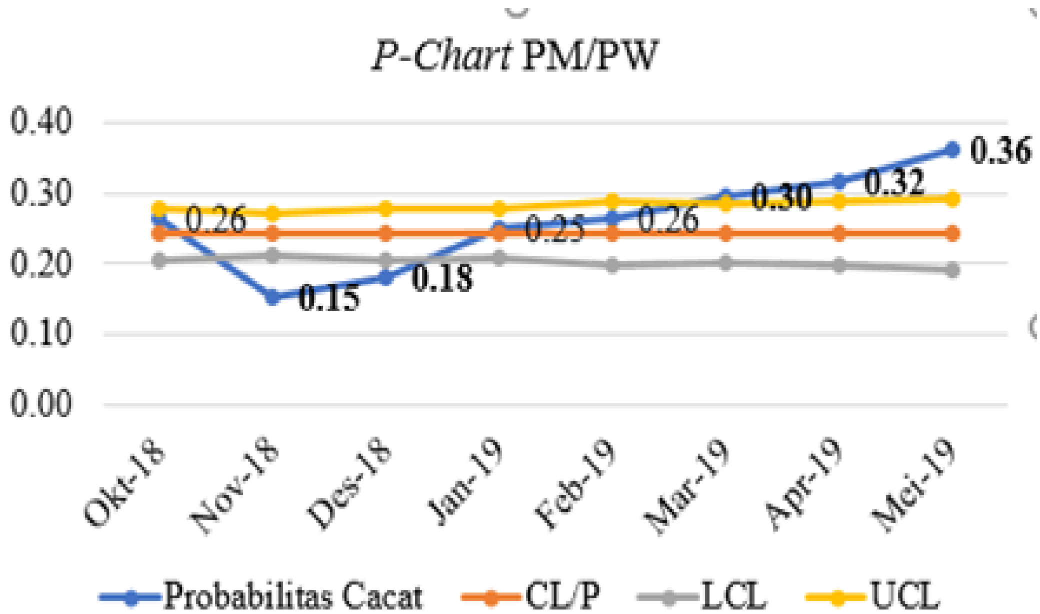

Figure 3. PM / PW Upright Piano (UP) Full Map

The proportion of defects that are outside the upper limit (UCL), namely in November-December 2018 and March-April-May 2019. If the value of the proportion of defects is outside the control limit, then it means that the cause affects the process and is said to be an unstable process and affects the production process.

3.3 Analyze

3.3.1. Pareto diagram analysis

The analysis is divided into two, which are frequent defects and what cabinets often defects occur in PT.X.

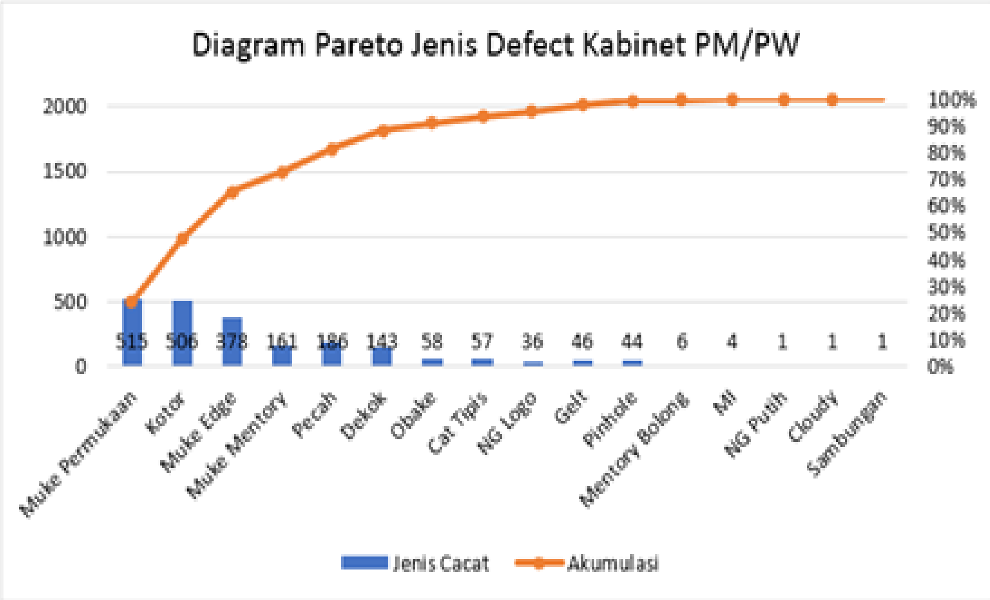

Figure 4. Pareto Diagram of defect

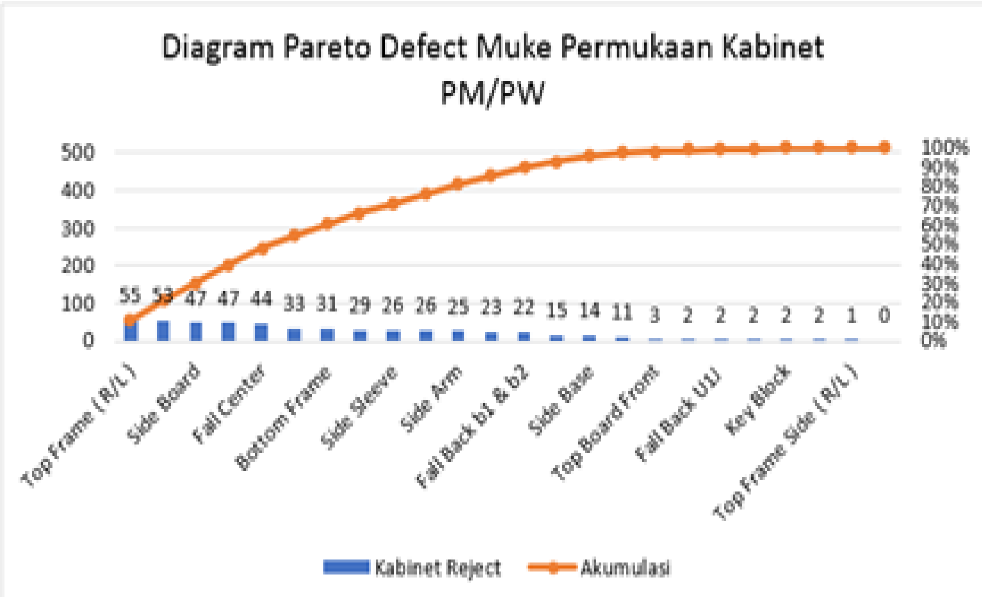

Figure 5. Pareto Diagram of Cabinet

Based on the results of the Pareto diagram in Figures 4. and 5. This research focuses on the type of muke permukaan defect on the top frame cabinet.

3.3.2. Fishbone Diagram Analysis

Here is a fishbone diagram of the causes of muke permukaan in the top frame cabinet:

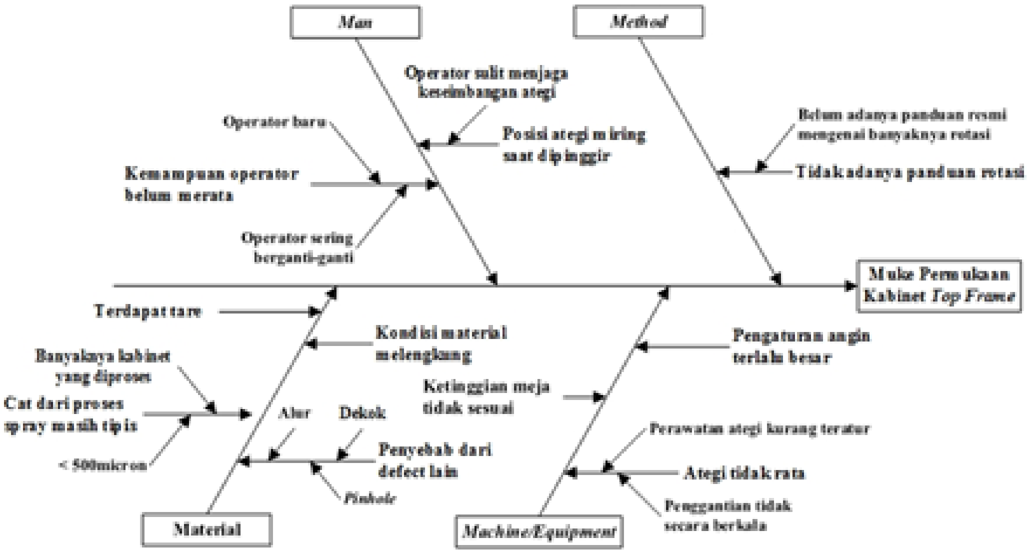

Figure 6. Fishbone Diagram of the Causes of Muke Permukaan Defects in the Top Frame Cabinet

Summary of Fishbone Diagram:

1. Man
   The operator's ability is not evenly distributed and when sanding the Ategi position is tilted at the edge
2. Machine/Equipment
   Ategi is rough, the wind settings are too large, and the height settings of the table on the machine dont match.
3. Method
   No rotation guide
4. Material
   There is a tare so that the cabinet position when the sanding process becomes tilted, the paint from the spray process is still thin (>500 microns), the cause of other defects, and the cabinet condition is curved more than the standard.

3.4 Improve

3.4.1. Failure Mode and Effect Analysis (FMEA)

From the results of FMEA, the highest Risk Priority Number (RPN) 2 is the cause of the man factor. The first level is the ability of operators who have not been evenly distributed with an RPN of 490 and improvement efforts that can be given are the position of energy must be flat when on the edge of the cabinet so that it does not miss, so it does not cause a muke permukaan defects on the cabinet and the balance during the sanding process must be maintained properly, so that the Ategi position is not easy to tilt and remains on the surface of the cabinet. The second highest RPN value is when sanding the sloping position at the edge with an RPN value of 294 improvement efforts that can be given are conducting training on basic skills to all operators who have long worked, implementing the OJT (On the Job Training) program during probation/probation period, so that new operators have equal opportunity (evenly) to work in all fields in the company and share knowledge, for example, knowledge owned by the working group, taught directly to the operator or if there are operators who have attended external training on skills certain, he is responsible for teaching other operators as well.

Proposed improvements made to minimize the causes of muke perumukaan defects based on the 2 highest RPN values in FMEA. The highest cause 2 is from the man factor. Improvement efforts that can be given are as follows:

1. When sanding the Ategi position is tilted at the edge (main factor)
   a. The position of Ategi must be flat when on the edge of the cabinet so it does not miss, and does not cause muke permukaan on the cabinet.
   b. Balance when making the sanding process must be maintained properly so that the position of the Ategi is not easy to tilt and remain on the muke permukaan defects.
2. The ability of operators who have not been evenly distributed (man factor)
   a. Providing training on basic skills to all operators who have worked for a long time.
   b. Implementing the OJT (On the Job Training) program during the probation period/probation period, so that new operators have the same opportunity (evenly) to work in all company areas.
   c. Sharing knowledge, for example, the knowledge possessed by work groups, are taught directly to the operator or if there is an operator who has attended external training on certain skills, he is responsible for teaching other operators as well.

4. KESIMPULAN

After discussion in this research, several conclusions can be drawn as follows.

1. The amount of data processing results obtained a Critical to Quality (CTQ) value of 16, the average DPMO value obtained for 8 months amounted to 16294.57, and the average sigma value of 3.65.
2. The factors that cause defects in the PM/PW Upright Piano (UP) cabinet based on the results of the fishbone diagram are ability of operators, the absent of rotation guide method, tare in sanding process, and from table setting in machine.
3. The highest value of Risk Priority Number (RPN) is when sanding the Ategi position is tilted at the edge (man factor) with an RPN value of 490. The second rank is the ability of operators who have not been evenly distributed (man factor) with an RPN value of 294.

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