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Research Article

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Improving Quality through Measurement of FMEA: A Case Study in a Manufacture Industry

Erwin Wijayanto, Choesnul Jaqin

Master of Industrial Engineering Program, Mercu Buana University, Jakarta, Indonesia

Abstract A manufacturing company that produces car body with of welding spots. The machine used to produce is a manual welding gun machine that is in the body shop maintenance section. The research was conducted from January to June 2018 and the method used was the method of Failure Method and Effect Analysis (FMEA). In sorting high downtime until the smallest uses the Pareto diagram. There are several causes of downtime such as wear tip cup with RPN 2223 value, chiller up to normal value of RPN 653, electricity value of RPN 646, air fitting RPN 555 value, balancer value of RPN 205 and aid cable RPN 154 value and an analysis will be made using the fish bone diagram.

Keywords Pareto Diagram, Failure Method and Effect Analysis (FMEA), Fish Bone Diagram

Introduction

Production of Body Shop is a part of combining several car body plates that have been produced from the Press Shop section. To combine all body plates into one unit, several processes are needed by going through several machines [1], one of them is the Manual Welding Gun machine. Next is the production flow in the production section of the Body Shop [2].

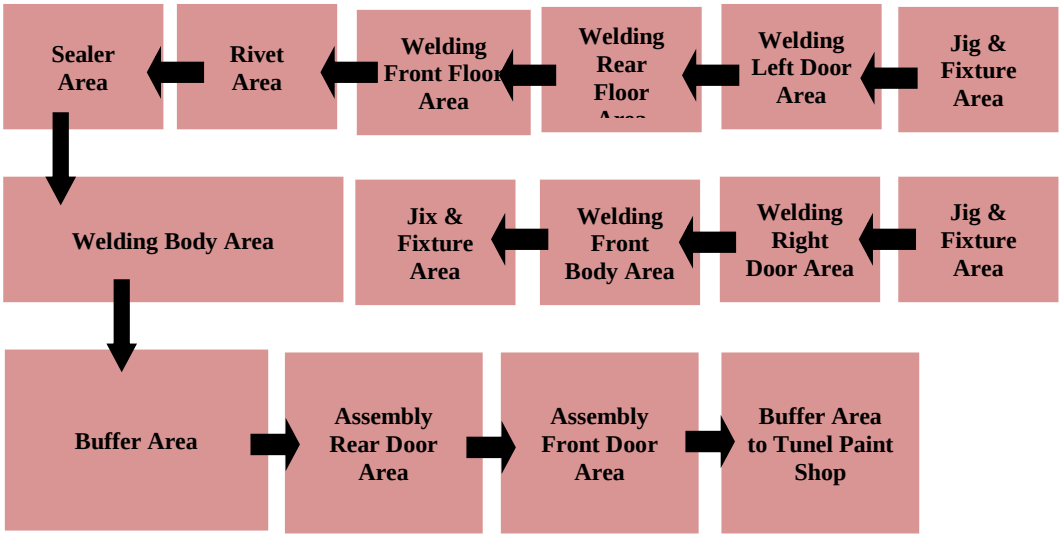


Figure 1: Body Shop production flow

In the process of merging the plates into the body of the car starts at the Jig & Fixture Area which is the plate merging area before continuing to the welding process [6]. After the welding process is complete, enter the Rivet Area process, which is an additional amalgamation which functions for plate locking. Next enter the

Sealer Area to check whether there are cracks in the welding, after that the welding process combines the body of the car with the robot. Buffer Area is the place after welding the car body that serves to accommodate the body of the car that has been welded, then proceed to the installation of the rear door and the front door of the car and proceed to the process of sending the car body ready for the painting process in the Paint Shop section [7]. The time needed from the Jig & Fixture process to the delivery of the car body to the Paint Shop section is four hours.

Failure Mode and Effect Analysis (FMEA) is a systematic approach that applies a labelling method to assist the thought process used by engineers to identify potential failure modes and their effects. FMEA is a technique for evaluating the reliability of a system to determine the effect of a failure of the system. Failure is classified based on the impact given to the success of a mission of a system. In general, FMEA (Failure Modes and Effect Analysis) is defined as a technique that identifies three things [3], namely: potential causes of failure of the system, product design, and processes during its life cycle, the effect of this failure, the critical level of the effect of failure on system functions [4,5], product design, and processes.

Research Methods

1. Methodology

In the FMEA method is used to determine the causes of the highest losses and reduce the failure mode that occurs in the engine with the many losses that occur so it is easier to identify the root of the engine and provide an alternative proposal using TPM pillars against losses that often occur based on brainstorming with Parties Company. Calculation of Risk Priority Number (RPN) in the FMEA method is measured using the root cause value of the damage [8,9]. The RPN formula is shown by the equation as follows:

RPN = Severity x Occurrence x Detection

The category of severity value with levels per six months

1. Engine downtime of less than 1 hour is very light category
2. Machine downtime between 1 to 7 minutes light category
3. Machine downtime between 7 to 15 minutes medium category
4. Machine downtime between above 15 hours in heavy category

Occurrence value categories with six-month levels

1. Machine downtime with a frequency of less than 5 times the category is very rare
2. Machine downtime with frequencies between 6 to 12 rare categories
3. Machine downtime with a frequency between 13 to 19 medium categories
4. Machine downtime with frequencies of more than 20 frequent categories

Detection value category

1. Machine downtime with potential is easily known to check visually with number 1
2. Machine downtime with potential is known to check with a tool or measuring instrument number 2
3. Machine downtime with the potential to be difficult to check by unpacking the supporting components with number 3
4. Machine downtime with potential is very difficult to know by checking by dismantling the main component with number 4.

The RPN determines the priority of failure. RPN has no value or meaning. The RPN is used to rank or rank potential process failures. The RPN value is obtained from the multiplication of the three indicators above.

2. Data Collection

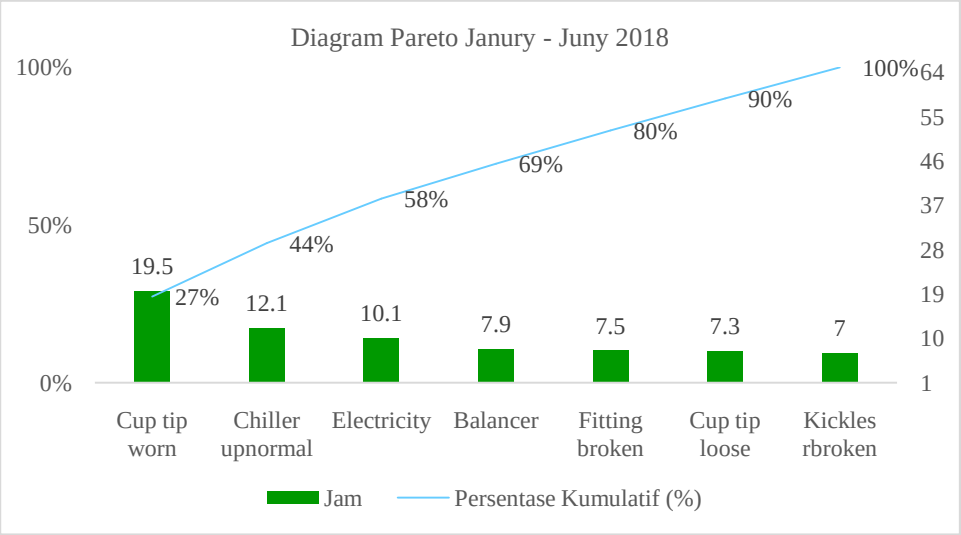
Pareto diagram serves to identify the main causes of downtime by classifying from the highest to lowest downtime obtained from data downtime from January to June 2018.

Table 1: Data downtime by hours January – June 2018

Month	Spare part setting		Machine break					Total downtime
	Cup tip worn	Cup tip loose	Kickles broken	Electricity	Fitting broken	Balancer	Chiller upnormal	
January	3.5	1	1	2	1	1	1	10.5
February	2	2	1.1	1	0.5	1	3	10.6
March	3.5	1.5	0.6	1	2	0.8	1	10.4
April	3	1.5	1.3	1	1.7	2	1	11.5
May	4	0.8	2	1.1	1.3	2.1	1.1	12.4
June	3.5	0.5	1	4	1	1	5	16
Total	19.5	7.3	7	10.1	7.5	7.9	12.1	

From table 1 below, it explains that the causes of the most downtime from January to June 2018 are caused by wear tip cups of 19.5 hours with a percentage of 27 percent.

Table 2: Percentage of diagram pare to January – June 2018



From the Pareto data diagram between January and June 2018, FMEA data can be concluded with the number of times the downtine occurs as follows:

Table 3: Downtime time January – June 2018 severity category

Month	Spare part setting		Machine break				
	Cup tip worn	Cup tip loose	Kickles broken	Electricity	Fitting broken	Balancer	Chiller upnormal
January	3.5	1	1	2	1	1	1
February	2	2	1.1	1	0.5	1	3
March	3.5	1.5	0.6	1	2	0.8	1
April	3	1.5	1.3	1	1.7	2	1
May	4	0.8	2	1.1	1.3	2.1	1.1
June	3.5	0.5	1	4	1	1	5
Total	19.5	7.3	7	10.1	7.5	7.9	12.1

The following is the total number of times of downtime on manual welding gun machines with the highest cause of downtime from worn cup tip.

Table 4: Occurrence of downtime January - June 2018 occurrence category

Month	Spare part setting		Machine break				
	Cup tip worn	Cup tip loose	Kickles broken	Electricity	Fitting broken	Balancer	Chiller upnormal
January	21	12	2	3	10	2	2
February	12	23	2	2	5	2	4
March	19	17	1	3	19	1	2
April	17	19	2	2	17	3	2
May	25	9	3	2	13	3	2
June	20	6	1	4	10	2	6
Total	114	86	11	16	74	13	18

The following detection category.

Table 5: Downtime January – June 2018 detection category

Item	*Cup tip* aus	*Chiller upnormal*	Kelistrikan	*Cup tip* kendur	*Air fitting*	*Balancer*	*Aid cable* dan *kickles*
Nilai	1	3	4	1	1	2	2

From the total downtime in January to June 2018 on manual weling gun machines, it was concluded with the FMEA table and the RPN value of more than 1000 which was the focus of the research as follows:

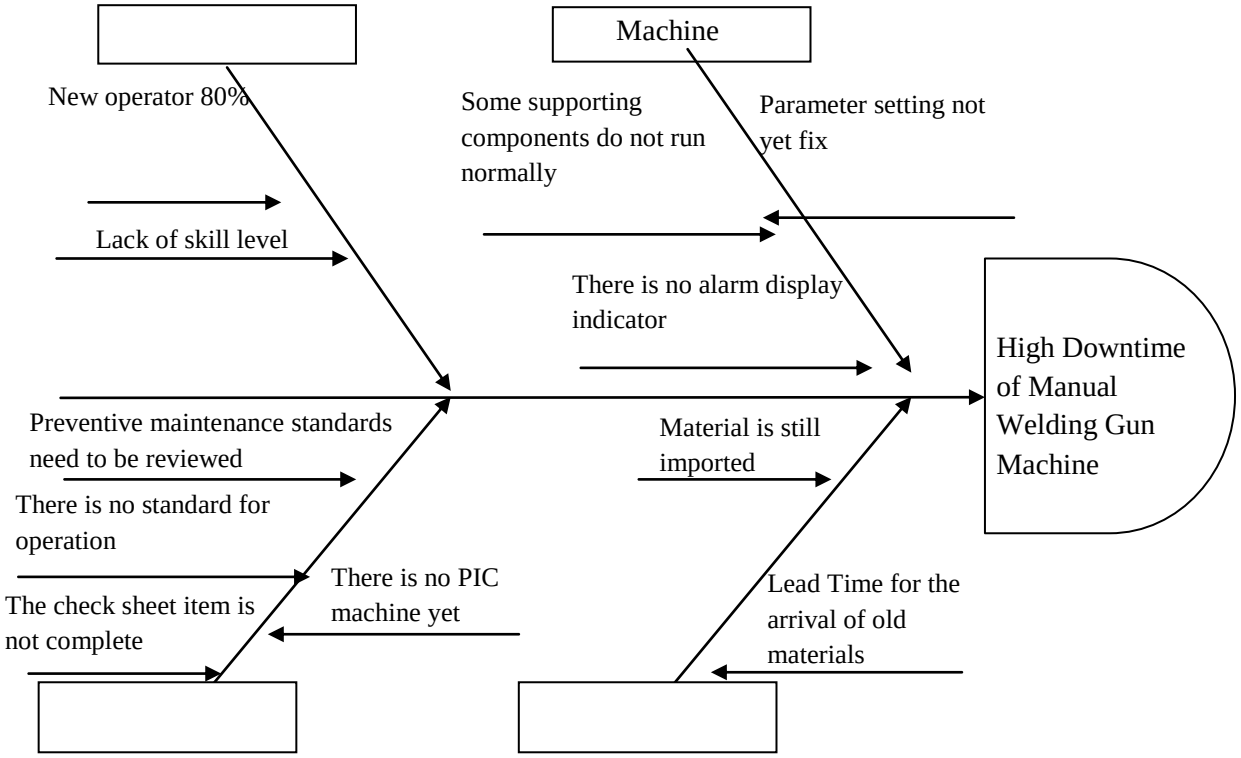
Table 6: FMEA table on manual welding gun machines

No	Downtime category	Impact the machine	Severity	Cause of downtime	Occurrence	Visualization done	Detection	Action taken	RPN
1	Cup tip worn	The result of welding is NG	19.5	Not quite right when installing a cup tip	114	Regularly visualize the surface of the cup tip	1	Perform preventive maintenance and PIC training of machines	2223
2	Chiller upnormal	The machine gets hot fast	12.1	Not all chiller components are checked	18	Visualization level gauge on water clarity and electrical panels	3	Perform periodic preventive maintenance	653
3	Electricity	The machine cannot operate	10.1	Not all electrical components are checked	16	Make sure all components are not dirty	4	Perform periodic preventive maintenance	646
4	Cup tip loose	The weld is not sticky	7.3	Due to machine vibration when operating	86	Regularly visualize the surface of the cup tip	1	Added lock thread when installing cup tip	627.8
5	Air fitting	The aid cable is	7.5	Many forms of fittings	74	Perform periodic	1	Replacing straight	555

		quick to heat because there is no air circulation		are straight type		visualization		fittings into L fittings	
6	Balancer	The arm cannot be lifted by the operator	7.9	Spring balancer broke	13	Perform periodic visualization	2	Lubrication on the rail rope balancer once a week	205.4
7	Aid cable and kickles	The weld becomes non-sticky	7	Check only once a week	11	Look at the aid cable component	2	Preventive maintenance is done every 2 days	154

From the FMEA table above the highest RPN value is in the downtime of the wear tip cup category of 2223, while the Pareto diagram of the cup tip clock downtime is also the highest as many as 19.5 hours and the downtime of events is 114 times in January to June 2018 the root of the problem is the high downtime on manual welding gun machines.

Table 7: Fish bone diagram cup tip worn on manual welding gun machine



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