ISSN : 1978-774X

QUALITY ANALYSIS USING FMEA METHOD ON ASSEMBLY PROCESSES OF WASHING MACHINE (CASE STUDY IN PANASONIC MANUFACTURING INDONESIA)

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ABSTRACT

PT. PANASONIC MANUFACTURING INDONESIA is a private company which is engaged in the electronics industry, which one of the products is washing machines.As the competition in home appliances industries is very tight, the consumer loyality through producing products with high quality and reliability is very important. One aspect to increase the reliability of products is removing potential failure modes, which can be analyzed using FMEA. FMEA is proactive method that analyzes the failure modes and its mechanisms and controls.By using FMEA, we can find the failure modes with highest risk which must be done corrective action. From our analysis using FMEA, the quality especially reliability of washing machine is good, as majority of Risk Potential Numbers are below 125, the citical RPN number in safety impacted product.The highest RPN number of modes of failure is 160 which spinning off failures mode caused by operator mistake while connecting the cable and the existence of fibrous cable. By doing corrective action for those causes,the RPN number is decrease to 64 and 96, which safe for the washing machine quality.
***Keywords**: FMEA, assembly processes of washing machine, quality control, reliability.*

1. INTRODUCTION

1.1. Background

Reliable product must be robust over time and free from mistakes. Unfortunatelly, as to err is human, engineers design velues into products as well as mistakes. The mistakes can be errors ranging from misuse of materials to misspecification of system requirements (Yang, 2007).

Ones of techniques for detecting and eliminating mistakes is FMEA or failure modes and effects analysis. FMEA is a proactive tool which formed from systemized group of activities intendednto recognize and evaluate the potential failures of a product or process and its effects then identify actions that eliminate or reduce the likelihood of the potential failure occurence and document the processes (SAE, 2002). Essentially, FMEA is bottom up process begins with identifying the failure modes at the lowest level as materials or components and work its group to determine the effect at the highest level as customers. As FMEA considers the effects at customers, which known as severity in FMEA, the overwhelming of FMEA implementation lied in sectors which consider safety very highly like industries of automotive, marine and defense.

From their implementation, FMEA has some benefits as identify which potential failure modes result in severe effects that must be disigned out or can be handled by corrective actions or which ones can be safely ignored. Because of these benefits, not only industries which highly connected to a safety which tend to use FMEA but spread out in many industries.

Panasonic Manufacturing Indonesia is one of the largest manufacturer of home appliances in Indonesia. Ones of its products is washing machine. Facing highly competition in market share, the company strive for producing high quality and reliability of their products. Their effort to preserve high quality product is to conduct quality control both in processes and products. To produce high reliability product, we suggest the using of FMEA method so that possibility of failures is reduced.

This paper studies the process FMEA of washing machine assembly processes in PT. Panasonic Manufacturing Indonesia. The outline of this paper is as follows. In section 2 we provide the theoritical

background of the process FMEA. In section 3 we explain research methods of studies. In section 4 we provide the result of developing FMEA of the process of washing machine assembly. Finally, in section 5 we give conclusions and discussions for future work.

2. THEORETICAL BACKGROUND

FMEA is proactive tool for discovering and correcting design deficiencies through the analysis of potential failure modes, effects and mechanisms, followed by a recommendations of corrective actions. Basically, FMEA may be classified into three categories according to the level of analysis: system FMEA, design FMEA and process FMEA. System FMEA is the highest level FMEA that can be performed and is used to analyze and prevent failures related to technologies and system configurations. Design FMEA is an analytical tool that used to identify potential failure modes and mechanisms,assess the risks of failures and provide corrective actions before the design is released to production. Process FMEA is a structured logic and systematic analysis intended to identify potential failure modes and mechanisms, asses the risks of failures and provide corrective actions before the first production run takes place.

Performing an FMEA begins with defining the system for study. The interactions between this system and others should be fully understood to determine the effects and mechanisms of a potential failure modes. Once the scope for FMEA study has been defined, the next steps are: 1). The lowest level component within the system is chosen and its function are analyzed. Each function should be technically specified and the failure criteria of the function must be defined completely. 2). Identify the failure modes of the component. For each failure modes,the responsible failure mechanism and their occurences are determined. 3). Develop control plans that help obviate or detect failure mechanisms, modes and effects. The effectiveness of each plan is evaluated by detection ranking. 4). Assess the overall risks of a failure mode. The overall risk is measured by risk priority number (RPN), which is product of severity, occurence and detection. A high RPN indicates a high risk of failure. Appropriate corrective actions should be taken to reduce the risk. 5). Finally, the result of FMEA are documented using a standardized format.

As FMEA has been standardized, ie. SAE J1739, IEC 60812 and MIL-STD-1629A, determine the values of severity, occurence and level of detection must refer to those standard.

3. RESEARCH METHOD

This study is done in PT. Panasonic Manufacturing Indonesia which produces home appliances in East Jakarta. We study the process FMEA of washing machine assembly process. Steps of study are: 1) Literate study 2). Collecting datas 3). Analysis using FMEA method 4). Suggestion corrective action and conclusion.
As stated in 2, this study is need the understanding of the system. Fortunatelly, for collecting data, the documentation of quality and process of the system can provides operation process chart, control plans and quality check sheets as evidence of failures and its mechanisms. The assembly process of washing machine is depicted in Figure 1.

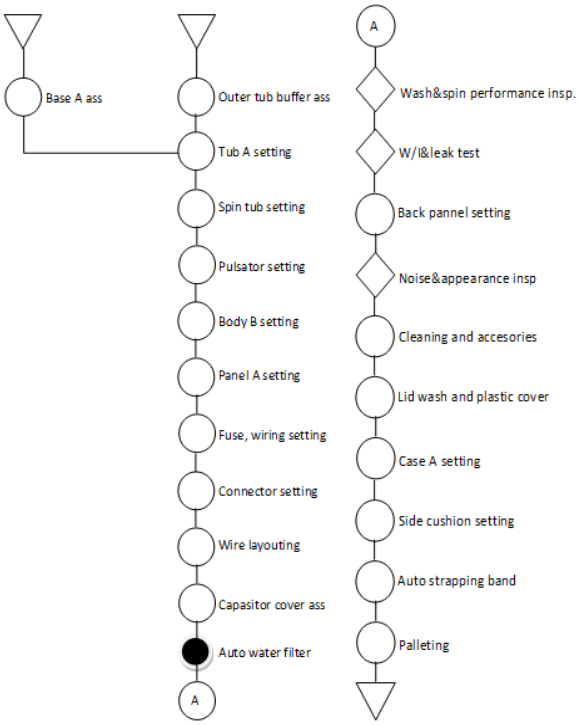

Figure 1. Process chart of washing machine assembly

The process chart can help the mechanims of failure modes. The control plans help us to identify the control which conducted to detect the failure modes. And the check sheets provide data of failures occurences. This data was collected in Desember 2011 – November 2012.

Next step is conducting FMEA analyis to analyze and improve the quality especially relibility of the product. As the study done after similar type of washing machine production processes took places, it can help to determine failure modes from failures which occurred in similar product.

After finishing the FMEA analysis, we choose the failure modes with high RPN number, RPN > 125, to get corrective action. Then we evaluate again the RPN number based on corrective actions which implemented.

Those processes is conducted iteratively until there is no RPN number which bigger than 125.

4. RESULT AND DISCUSSION

The results of FMEA analysis are described in table 1.

1) From the check sheets, we get failure modes as water leakage, appearance not good, spinning off, washing noise, washing off, cannot drain, washing one way rotation, coupling loss etc. Water leakage, appearance not good, spinning off and washing noise contribute 80% of failures. We concern the study to analyses these failures.
2) Next step is to identify the failures modes, mechanisms and occurrences.

a). Water Leakage/Bocor

From FMEA table, water leakage failure cause washing machine doesn't be operable or loss it's primary function. In level of severity it chooses 8. This failure is caused by buffer not attachs well, tube cracks caused of time of attaching buffer too long and press machine breakdowns, operator forget to attach valve and material tub not good. If buffer does not attach on tube A and or valve not attached, tube A will suffer leakage. This failure is most dominant failure in this assembly procsesses. Now, the company applies sensor while processing and also sample inspection of product. This product inspection is done with filling water in tube. The other methods for detecting of the causes of this failure described in table FMEA. For its level of detection, sensor has level of 3 as it has high chance to detect a potential causes of failure. Detection level of 5 for the other methods as they have moderate chance to detect failure. As occurence below than 1 per 1000 washing machine then occurence for buffer not attached is 3. This numbers come from QC checksheet which conducted in production line. Then the RPN number for as example water leakage failure caused by buffer not attached is 8 x 3 x 3 = 72. The complete RPN number described in FMEA table.

b). Appearance NG

Appearance NG failure causes outside appearance of washing machine does not comply the specification. The failure mostly caused by there are sctrachs and dentes on outside case of washing machine. The scratchs and dentes usually happen along assembly processes when operators do not work carefully so the cases collide each other. The method to detect this failure is visual inspection. Level of severity, occurence and detection described inFMEA table.

c). Spinning Off/ Motor Spin Mati

Spinning off leakage causes washing machine cannot operate. Factors that can cause this failure are operator is wrong while connecting cable, there are fibrous cable and cable material is not as specification. The most factors from datas are wrong connection and fibrous cable. To control this failure, company conduct inspection after the connecting cable process also sample inspection of product. As level of detection of operator and sample inspection is having moderate chance to detect failure, the level of detection is chosen 5. For this failure, the RPN number is found high as 160.

As critical RPN number for automotive industries –the industry which has had standar of FMEA- is 125, we do benchmarking to addopt the critical RPN

number. So we must do corrective action if the RPN number more than 125.
From illustration in first paraghraph of c), the RPN number of spinning off caused by wrong connection and fibrous cable is 160. So we must do corrective action. We suggest colour identification of cable so operator just connect cable for the same colour. This corrective action will remove the potential cause. From the project pilot implementation, it found that there are no more wrong connection cable. For the fibrous cable, we suggest sensor which can detect the fibre.

d). Motor vibration is not stable or washing noise.
Washing machine failure will cause the item operate with uncomfort or unconvenience. It will reduce the satisfaction of customer. This failure is happened in motor and caused by wrong direction while attaching motor pulley, sideways direction while attaching pulsator and not enough tight while attaching spin tube. These all causes mostly happen cause of the off of screw driver while the compressor is off. But as the most occurence is not tight attaching spin tube and the RPN for this is 120, we suggest the corrective action as give a automatic setting in screw driver and maintenance of compressor accurately so the time of attaching is correct accurately.

5. CONCLUSION

From our observation, analysis and description above, we conclude that the quality and reliability of washing machine is good, as the RPN number which higher than 125 that is spinning off failure mode which caused by wrong connection cable and fibrous cable. As corrective action conducted and implemented well, the new RPN number decrease to 56 and 84 which quarantee the quality and reliability.
Our suggestion conduct FMEA analysis in another products not only in automotive industries. For company, our suggestion is to implement the method of quality control which has been assigned accurately.

6. REFERENCES

(a) Ariani, Dhorotea Wahyu. 2006. *Pengendalian Kualitas Statistik*. Ghalia Indonesia. Jakarta

(b) Gyrna, Frank M. 2001. *Quality Planning and Analysis From Product Development through Use*. Mc Graw Hill Irwin. Singapore.

(c) *SAE J1739.* 2002*.*

(d) Yang, Guanbin. 2007. Life Cycle Reliability Engineering. John Wiley & Sons, Inc. New Jersey.

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Table 1 FMEA of Washing Machine Assebly

Modus	**Effect**	**S**	**Causes**	**O**	**Controling**	**D**	**RPN**	**Recommend-ed Action**	**S**	**O**	**D**	**RPN**
Water Leak-age	Washing machine not properly function	8	Buffer doesn't patch	3	Sensor	3	72	-				
			Tube broken because the instalment take to long	4	Sensor	3	96	-				
			forgot to instal the valve packing	4	Sensor	3	96	-				
			Press machine jammed so damaging tub	3	Weekly machine maintenance	5	120	-				
			Material tub doesn't meet the requirement	3	AQL material reception	5	120	-				
Appear ance NG	Surface doesn't meet the requirement	4	Surface dirty	3	Inspections by the operator in the product	5	60	The use of control charts P	4	3	4	48
			Scratch on the surface	2	Inspections by the operator in the product	5	40	-				
Spin-ning Off	The machine doesn't work	8	mistake on the connecting cable	4	Inspections by the operator in the proses	5	160	Identify the cable that connected	8	4	2	64
			Fiber cable comes out of the connector	4	Inspections by the operator in the proses	5	160	Sensors that detect fiber	8	4	3	96
			Material doesn't meet the requirement	3	Inspections of the material reception	5	120	Improvements in supplier	8	2	5	80
Wash-ing Noise	Washing machine not properly function	6	Installation of the motor pulley is incorrect	3	Inspections by the operator in proses	5	90	-				
			Installation oblique pulsator	3	Inspections by the operator in proses	5	90	-				
			Installation spin tube is not tight	4	Inspections by the operator in proses	5	120	Setting the time and magnitude of electrical	6	4	3	72