



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**PROBLEM SOLVING OF FOOT SWITCHES
PROCESSES USING FAILURE MODE AND
EFFECTS ANALYSIS**

Thesis submitted in accordance with the requirements of the
Technical University of Malaysia Malacca for the Degree of
Bachelor of Manufacturing Engineering (Manufacturing Process)

By

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Faculty of Manufacturing Engineering
May 2007



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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JUDUL: PROBLEM SOLVING OF FOOT SWITCHES PROCESSES USING FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

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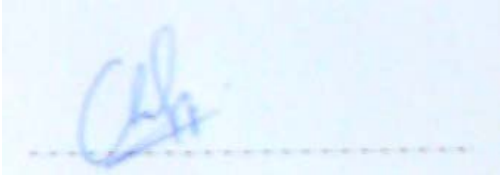
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ABSTRACT

This study presents the Failure Modes and Effects Analysis (FMEA) is a systematic approach that identifies potential failure modes in a manufacturing and final assembly operation caused by manufacturing process deficiencies. The FMEA also is a tool used to prevent problems from occurring. The FMEA is a methodology used by the manufacturing industries to analyze and discover all potential failure modes of a process function, identify the effects these failures on the process and how to correct and mitigate the failures or effects on the process.

The Process FMEA is applied on manufacturing processes in the industry i.e. foot switches to reduce the failure modes and preparing the preventions and recommended actions to reduce the failure as much as possible, reduce costs and improving the product quality. The study discusses steps to conduct the Process FMEA methodology. The research by observation and collect data of failures occurred at the paint line and final assembly section in the manufacturing processes.

The Risk Priority Number (RPN) is calculated with a suggested severity, occurrence and detection evaluation criteria table provided as a guide to find the ranking for the failures occurs. The discussion regarding the results and how to improve the failures with the recommended actions is given. These actions are meant to reduce the Risk Priority Number (RPN), so that the method of Process Failure Mode and Effects Analysis (PFMEA) is effective to use for this foot switches manufacturing processes. To surpass the expectations or demands of customers, the FMEA is compulsory to apply on the products and manufacturing processes and also the PFMEA brings more benefits to the customers and organizations.

ABSTRAK

Kajian ini mengenai mod kegagalan dan kesan analisis adalah salah satu cara dan peralatan yang sistematik digunakan untuk mencari kegagalan-kegagalan dalam proses pembuatan dan pemasangan atau pengumpulan terakhir sesuatu produk. Mod kegagalan dan kesan analisis ini adalah sesuatu metodologi yang digunakan oleh industri-industri pembuatan untuk menganalisis kegagalan proses pembuatan, mengenalpasti kesan-kesannya dibawa kepada proses atau produk dan memberi cara untuk menyelesaikan masalah dan mengurangkan kesan kegagalan ke atas proses pembuatan.

Mod kegagalan dan kesan analisis proses ini dipergunakan dalam industri pembuatan, contohnya industri yang menghasilkan suis kaki. Mod kegagalan dan kesan analisis proses ini akan mengurangkan kegagalannya, kos dan memperbaiki kualiti produknya yang dihasilkan. Kajian ini juga memperbincangkan cara-cara bagaimana melaksanakan mod kegagalan dan kesan analisis proses, cara-cara pemerhatian dan pengumpulan maklumat-maklumat kegagalan yang berlaku semasa proses mengecat dan pemasangan terakhir dijalankan.

Angka risiko keutamaan dapat dikira dengan merujuk kepada jadual kegentigan kesan, kemungkinan kejadian dan kemungkinan penemuan yang darjat sebagai panduan untuk memilih peringkat kegagalannya. Perbincangan and cadangan-cadangan diberikan untuk menyelesaikan masalah kegagalan dengan kelakuan yang berkesan dengan tujuan untuk mengurangkan angka risiko keutamaan di dalam proses pembuatan suis kaki. Untuk memuaskan and memenuhi permintaan pelanggan, mod kegagalan dan kesan analisis metodologi digunakan untuk mengelakkan kegagalan dan ianya akan membawa kebaikan yang lumayan kepada pelanggan-pelanggan dan organisasi-organisasi.

DEDICATION

*For my beloved parents (Mr. Lee Hock Chye & Mdm. Lim Kim Nai),
elder brother (Mr. Lee Choon Wei) and elder sister (Mdm. Lee Yean Li)*

ACKNOWLEDGEMENT

All budding graduates encompasses from every faculty in Universiti Teknikal Malaysia Melaka, (UTeM) are required to carry out a project in one's related field of study during the final year. It is compulsory task for all undergraduates in order to graduate from one's bachelor's degree in a particular field. As a result, this project had been carried out based on the selected topics listen by the Faculty of Manufacturing Engineering. Thus, the project chose entitled "Problem Solving of Foot Switches Process Using Failure Mode and Effects Analysis – Process FMEA" is a combination of research by observation method and data collected. The project was assisted and guided by lecturer @ supervisor, Prof. Madya Dr. Adi Saptari . This investigation and observation of research of problem solving of foot switches process using FMEA at LIKOM Caseworks Sdn. Bhd.

In conjunction to this, I would like to offer my deepest gratitude to Prof. Madya Dr. Adi Saptari from the bottom of my heart for all the support, encouragement and inspirations I manage to obtain all the way through of this project. The excellent working relationship between my supervisor and me has provided me with bountiful knowledge and experience for the future. The help rendered to me is priceless, be it from the smallest of its kind to the largest. Besides that, I would like to thank Mr. Chua KY and other workers Mr. Chua whom has exposed me to the paint line and final assembly section to conduct the research. Last and not least, my highest thankfulness to my family, course mates, friends and other parties whom have helped me directly or indirectly. Especially, I would to express my sincere appreciate to Ms. H'ng Kar Kee whom are

helps me to use the Microsoft Excel in effective way and more easily to complete a part of my thesis.

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LIST OF SYMBOLS

FMEA	-	Failure Modes and Effects Analysis
S	-	Severity
O	-	Occurrence
D	-	Detection
PSM	-	“Projek Sarjana Muda ”
RPN	-	Risk Priority Number
PFMEA	-	Process Failure Modes and Effects Analysis
QA	-	Quality Assurance
QC	-	Quality Control
Eng.	-	Engineering
FMECA	-	Failure Modes, Effects, Critical and Analysis
MIL-STD	-	Military Standard
SAE	-	Society of Automotive Engineers
IEC	-	International Electro-technical Commission
RCM	-	Reliability Centered Maintenance
LCW	-	LIKOM Caseworks
DI	-	Degreasing I (one)
RNK	-	Ranking
SPC	-	Statically Process Control
M	-	Meter
Min	-	Minute
OM	-	Observation Method
P	-	Probability
DVI	-	Double Visual Inspection

SOP	-	Standard Operating Procedure
JCAHO	-	Joint Commission on Accreditation of Healthcare Organizations
QS	-	Quality System
QuaDCost	-	(Quality, Delivery, Cost)
TQM	-	Total Quality Management
ISO	-	International Organization for Standardization
R&D	-	Research and Development

LIST OF APPENDICES

Appendix A - Foot Switches Product for each model (D692-08 / D692 - 07 / D692-06)
(cover and base).

Appendix B – A Risk Based Approach to RPN.

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CHAPTER 1.0

INTRODUCTION

1.1 Background of the Study

Nowadays, customers are placing increased demands on companies or organizations for high quality and reliable products. The increasing capabilities and functionality of many products are making it more difficult for manufacturers to maintain the quality and reliability. But the quality and reliability is most important to attract the customers to buy the products when a product quality surpasses their expectations. To ensure or minimize the risk of failure through the use of Failure Mode and Effect Analysis (FMEA), a proven method for minimizing failure in products, designs and processes. Besides, the FMEA is an easy to use and yet powerful pro-active engineering quality method that helps to identify and counter weak points in the early conception phase of products and processes. So, to surpass the expectations quality from the customers, the quality method of Failure Modes and Effects Analysis (FMEA) is apply to identify potential failure modes, determine their effect on the operation of the product, and identify actions to mitigate the failures. In addition, the FMEA also is analyzing potential reliability problems early in the development cycle where it is easier to take actions to overcome these issues, thereby enhancing reliability through design.

Failure Modes and Effects Analysis is a methodology to analyze and discover all potential failure modes of a system, the effects these failures have on the system and how to correct or mitigate the failures or effects on the system. In other word, the FMEA four simple words also can explain in: an analysis of the effects of failures.

Generally, the failure mode and effects analysis (FMEA) is the most widely used analysis procedure in practices at the initial stages of system development. And the FMEA is usually performed during the conceptual and initial design phases of the system in order to assure that all possible failure modes have been considered and that proper provisions have been made to eliminate all the potential failures. The important part of FMEA also includes analyzing the criticality, which is how harmful the effects of a failure mode are on system operation. So the criticality is considered in a FMEA, the name is changed to Failure Mode, Effects, and Criticality Analysis (FMECA).

The task of this final year project is applying the FMEA concepts and doing the research on the processes of foot switches product in the manufacturing industry at Malacca. The research is conducting on each process on the production of product and to ensure or finding out the failure modes is occurring in the earlier of processes. The researching of a FMEA in this manufacturing industry able to be minimize the failures in the processes of product, increasing the product quality, saving costs and achieved the customer's expectations. The problems is recording in the data sheet for easily to do the analysis of the problems or failures is countering and making the result for the product processes and to reduce the failures as much as possible on the processes of foot switches production. The research of FMEA is important for every products, designs and processes to make sure the quality is maintained and satisfy the customer's requirements. This research is most important task for the student to complete the final year project and the thesis writing.

The FMEA method also is widely used and studied by many companies and organizations like automotive industry, aerospace and electronics. Sometime the problems are existed on products can not to be avoid, so some of the smart companies are using the FMEA as a element key for their organization's and use that properly to save hundred of thousands of dollars and report higher levels of customer satisfaction.

In short, maximizing the failure mode and effects analysis (FMEA) method in your organizations to reduce the failures or risks of product in the processes and design as much as possible and also can make the improvements on the products quality

problems is facing and designs and producing the products in high quality stages to achieve the requirements of customers.

1.2 Problem Statement

The FMEA is one of the methods applied to reduce or avoid the failures and risks on the product through research, analysis, quality improvements and rearrange the production method to be more satisfied by the organizations and customers. Normally, the products are easily to become damaged, break and the failures existed because of the quality and reliability of products is performed by the companies. The low quality and reliability problems of product are happened, it is because of the higher productivity in one day and possible some of the companies want to reduce the costs and producing low quality products. Due to its benefit, the FMEA method should be used by all companies in proper way like a powerful tool to make sure the products producing in the low failure modes condition and to produce a more quality products to satisfy the customers demanded.

The main purpose of the research is find out the failures on the foot switches production such as in the inspection sessions make sure never mix the part cover and base together and when doing the spraying process ensure no less powder in the internal surface. When the failures is detected, finding what is the reasons to make each of the process become failure modes and preparing the control prevention method to avoid the failure modes and producing a quality product where it can save the times and costs.

1.3 Objectives of Study

The Objectives of this project are as follow:

1. To understand the basic concepts of the Failure Mode and Effects Analysis solving manufacturing problems and make the quality improvement on the products or processes.

2. To identify failures and their effects in the foot switches production.
3. To evaluate the potential failure of foot switches manufacturing process through use of Risk Priority Number (RPN).
4. Recommend improvement of foot switches process to reduce Risk Priority Number (RPN).

1.4 Scope of Project

The quality and reliability of products is very important role to make sure the products is produced in low or none failure modes are happening and could be satisfied by the customers when the products are used.

The scope of the project is regarding the investigation and research of failure modes and effects analysis (FMEA) that used in the manufacturing industry to solve the problems of failure modes are occurring on the productions and each process of foot switches (foot pedal) product. Find out the failure modes with research and observation method from the paint line and final assembly section in production of foot switches is produced and preparing/give some prevention and recommended actions for this problem. The quality method of FMEA tool is applied in the FMEA worksheet and doing the analysis and giving the suggestion for problems solving and make do the prevention to avoid all the failure modes from occurring as much as possible.

The FMEA project is researching based, observation and give suggestions for each of the problem had been given or faced to ensure so that the problems could be fully curb or at least minimized as much as possible. In the short, the FMEA project is done for finding out the failure modes from the specified product (foot switches) is produced by the manufacturing industry. Apply the FMEA method to solve the problems and to avoid the failure modes are found. Then doing the prevention and taking the recommended actions to reduce the failure modes are occurring on the foot switches manufacturing process and to decrease the Risk Priority Number (RPN) for each process function. In order that, to produce the more quality, reliability and low failure modes foot switches product in the production of paint line and final assembly section.

CHAPTER 2.0

LITERATURE REVIEW

2.1 History of FMEA

The Failure Mode and Effects Analysis (FMEA) process was originally developed by the US military in 1949 to classify failures "according to their impact on mission success and personnel/equipment safety". FMEA has since been used on the 1960s Apollo space missions. In the 1980s it was used by Ford to reduce risks after one model of car, the Pinto, suffered a fault in several vehicles causing the fuel tank to rupture and it to subsequently burst into flames after crashes. [16:09, 23 October 2006, the Wikimedia Foundation, Inc. (from Wikipedia, the free encyclopedia)]. From the (SDAQM 2005 Spring Conference, Shari Aman), it was developed by reliability engineers in the late 1950's have to determine problems that could arise from malfunctions of military systems.

- ❖ First used by the military for aerospace development in 1949
- ❖ Used by industry (Ford Motor Company) in late 1970's
- ❖ Adopted in healthcare with JCAHO's help in 2000
- ❖ Formal applications began in Aerospace industry (mid 1960 s) now widely used in Automotive industry.

FMEA have been around for a very long time. Before any documented format was developed, most all inventors and process experts would try to anticipate what could go wrong with a design or process before it was developed. The trial and error

alternative was both costly and time consuming. FMEA were formally introduced in the late 1940's with the introduction of the MIL-STD-1629A. Used for Aerospace/rocket development, the FMEA and the more detailed FMECA were helpful in avoiding errors on small sample sizes of costly rocket technology.

2.2 Failure Modes and Effects Analysis (FMEA)

From the information found for this chapter, nowadays many organizations or companies have used the Failure Mode and Effects Analysis (FMEA) process for years. The QS-9000's mandate that suppliers utilize FMEA during making new product designs and development has shed new light on this useful tool. Besides the automotive industry, many other industries including aerospace and electronics now use the FMEA (*By Richard A. Harpster*). The applications of FMEA are applied as a powerful tool in different organizations to reduce the failure modes and increasing quality of products, processes and designs is presented. Failure mode and effects analysis defined as a reliability engineering method that helps product-development teams identify and prioritize the severity of potential functional failures of new product or process designs. Others definition of FMEA is (1) A "systematic method of identifying and preventing product and process problems before they occur". FMEAs focus on identifying and removing defects, enhancing safety and increasing customer satisfaction.",(2)A procedure by which each potential failure mode of a component, equipment or sub-system in a system is analyzed to determine the results or effects thereof on the overall system and to classify each potential failure mode according to its severity and (3) System analysis by which each potential failure in a system is analyzed to determine the effects on the system and to classify each potential failure according to its severity and likelihood. [*Jan H ERIKSEN, July 2001, ARMP-7 edition 1*), (*Federal Aviation Administration, 22 March 2006*) & *Institute for Safe Medication Practices, 2002*]. The purpose of an FMEA is to identify single equipment and system failure modes; it is not designed to identify an exhaustive list of combination of equipment failures that could lead to an accident. (*Fthenakis V.M & Trammell S.R., Reference Guide for Hazard Analysis in PV Facilities, September 2003*)

It's also to identify design areas where improvements are needed to meet the reliability requirement. FMEA is often the first step in a systems reliability study and it involves reviewing as many components, assemblies and subsystems as possible to identify possible failure modes and the causes and effects of such failures. For each component, the failure modes and their resulting effects on the rest of the system are written onto a specific FMEA form. There are numerous variations of such forms. An example of an FMEA form is shown in Appendix A. This risk management tool is used by companies to limit their exposure to litigation while at the same time satisfying their customer's expectations. *(Dr. Ghassan Tarakji, Tool of Risk Management, Engineering 801: Engineering Management April 23, 2003)*

An FMEA becomes a Failure Modes, Effects and Criticality Analysis (FMECA) if criticalities or priorities are assigned to the failure mode effects. The FMEA technique is used as an integral part of an RCM (Reliability Centered Maintenance) analysis. One main idea of RCM is to prevent failures by eliminate or reduce the failure causes. The FMEA analysis should therefore focus on the failures causes and failure mechanisms. When the failure causes and failure mechanisms are identified for each failure mode, it will be possible to suggest time based preventive maintenance actions, or condition monitoring techniques to reduce the resulting failure mode. Engineer and managers use this tool during the design phase of a product or process to help them establish priorities and resource allocation to be applied to the most critical aspects of a product's design. During the design process, a development team identifies possible product failures that might generate a negative result such as an inconvenience to a customer, loss of money for a company, or even injury to a user. Once these potential failures are identified, they are assigned a priority based on their likelihood and severity. This allows the development team to focus on improving aspects of the design that will provide the most benefit to the company. A company may use this tool for processes, products or any other complex system that may have multiple points of failure.

(Jorn Vatn, Introduction to Failure Mode and Effect Analysis, 22-12-2000)