UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MISTAKE PROOFING JIG A METHOD TO IMPROVE RISK PRIORITY NUMBER (RPN) IN PROCESS FMEA

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Manufacturing Engineering Technology (Process & Technology) (Hons.)

by

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Mistake Proofing Jig a Method to Improve Risk Priority Number (RPN) in Process FMEA**

SESI PENGAJIAN: **2014/15 Semester 2**

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This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Manufacturing Process and Technology) (Hons.). The member of the supervisory is as follow:

……

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ABSTRAK

Tujuan projek ini dijalankan adalah untuk melaksanakan konsep *mistake proofing* yang digunakan dalam proses pengeluaran sesuatu produk. Proses FMEA boleh dijadikan sebagai alat untuk mengawal kualiti yang digunakan untuk mengenalpasti, menganalisis dan mengutamakan kegagalan pada produk dan proses dengan mengurangkan risiko penghasilan barang yang rosak dan juga dapat meningkatkan kualiti, produktiviti dan profit. Masalah besar di dalam proses di sebuah syarikat adalah kesalahan pekerja dan kadar barang yang rosak. Setiap hari, pelbagai masalah dihadapi berkaitan dua faktor ini seperti menghasilkan barang rosak, tidak mengikut kehendak pelanggan, pembaziran masa dan wang, dan juga kesan terhadap kualiti produk. Langkah terbaik yang boleh diambil adalah memperbaiki RPN dalam proses FMEA dengan mengunakan konsep *mistake proofing*. Kaedah DMAIC digunakan dalam menghasilkan hubungan di antara mistake proofing dan PFMEA. Apabila FMEA dikaitkan dengan teknik *mistake proofing*, proses pengeluaran akan menjadi lebih baik, lebih tepat dan selamat. *Mistake proofing* adalah konsep mudah yang boleh dilaksanakan oleh manusia kerana ia dapat mencegah dan mengesan masalah yang ada pada produk yang dihasilkan. Jika masalah itu dikesan, produk itu akan di semak semula untuk memastikan tiada barang yang rosak dalam pengeluaran. Bagi syarikat yang berusaha sebaik mungkin untuk mencapai *Zero Defect*, kajian ini adalah sangat berguna untuk mereka dalam membuktikan teori keberkesanan konsep *mistake proofing* melalui proses FMEA.

ABSTRACT

This project is aimed how to perform mistake proofing concept that use to control the product and process during the mass production. Process FMEA concept can be quality management tool that use to identify, analyzing, and prioritizing failure modes of a product and process by reduce the risk of producing defective part and also improve the quality, productivity and profit. The major problems in the process at the company are human mistake and higher reject rate. Every day, there are always have problems regarding this two factors such as producing some defective product, not fulfil customer requirements, waste time and money, and it also effect to the product quality. The best action to improve the risk priority number (RPN) in process FMEA is by using mistake proofing techniques. The DMAIC method is used to implement the correlation between the mistakes proofing technique through PFMEA level. When the FMEA is linked with the mistake proofing techniques, the production process become more reliable, more tolerant and safe. Mistake proofing is a very simple concept to be implement by human because it can prevent the problem and also can detect the defect of the product. If the problem is detected, the product will be rework to ensure there are no reject parts on production. For those company strive as much as possible for Zero Defect, this study is very useful for them to perform and analyze the mistake proofing effectiveness through PFMEA.

DEDICATION

To my beloved parents

ACKNOWLEDGEMENT

Firstly, I would like to take this opportunity to express my sincere acknowledgement to my supervisor Engr. Mohd Soufhwee Bin Abd Rahman from the Faculty of Engineering Technology, Universiti Teknikal Malaysia Melaka (UTeM) for the essential supervision, support and encouragement towards the completion this PSM project.

Special thanks to UTeM grant funding for the financial support throughout this project. Special thanks to all my peers, my beloved mother and father, and siblings for their moral support in completing this degree. Lastly, thank you to everyone who had been the crucial parts of realization of this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

FMEA	-	Failure Mode and Effect Analysis
PFMEA	-	Process Failure Mode and Effect Analysis
RPN	-	Risk Priority Number
DMAIC	-	Define Measure Analyze Improve Control

CHAPTER 1
INTRODUCTION

This project is used to introduce of Failure Mode and Effect Analysis (FMEA) system that have been applied in all industry a few years ago and to identify how effective FMEA system when the FMEA is related with the mistake proofing techniques in the industry. The term "failure mode" has combine two words that each word has interesting meaning. The Concise Oxford English Dictionary defines the word "failure" as the act of ceasing to function or the state of not functioning while the word "mode" is defined as a way in which something occurs. The word "effect" defines the consequence of the failure on the system or end user. According to the John J. Casey, FMEA is a method to systematically look for everything that can go wrong and to look for ways to address it. FMEA also can be defined as a quality management tool that use to identify, analyzing, and prioritizing failure modes of a product and process by reduces the risk of producing the defective parts and also improve the quality, productivity and profit.

This system of "FMEA" can help people to manage the production process from the beginning of a process through the period of the production. It also helps to prevent problem or error from occurring or detect, and react to variation in the process before they materialize as product defect. The traditional FMEA determines the risk priority of failure modes using the risk priority number (RPN) by multiple the ranks of the three element of risk namely Severity (S), Occurrence (O), and Detection (D).The best action that can be taken for high risk problems (especially those have high RPN) are using mistake proofing technique or systems In addition, when the FMEA system is linked with the mistake proofing techniques, the production process will become more reliable, tolerant, and safe.

According to Robinson and Harry, Poka-Yoke is a Japanese term that defines “fail-safing” or “mistake-proofing. Mistake proofing is a mechanism in the lean manufacturing process that helps people or operator to prevent mistake. The purpose of the mistake proofing is to eliminate product defects by preventing and rectifying to human errors as they occur. On the other hand, when defect can be prevent by applying mistake proofing in FMEA system, the process control can be minimized and eliminated entirely. Thus, this approach is initializes quality performs and improve the production process.

1.1 Background

Mistake proofing is useful and powerful devices during the FMEA system which is will function as detection approaches of a product and process by reduces the risk of producing the defective parts during the production process. It is not possible to prevent and eliminate all mistakes that people make. Human errors can be reduce and prevent from reaching defective parts to the customers by using this techniques. Problem and error can be minimizing and eliminate as soon as possible if something occur to the quality of the product. Mistake proofing is a very simple method to avoid mistake and improve quality. For those company want to achieve Zero Defect, this techniques will be useful for them.

1.2 Problem Statement

In the repetitive manufacturing process, there are several problem could be happen. When the problem occurs, it will make the process become slowly and its effect to the others department. The major problems in the process are human mistake and higher reject rate.

Every day, there are always have problems regarding this two factors such as producing some defective product, not fulfil customer requirements, waste time and money, and also effect to the product quality. Develop effective FMEAs will identify causes, solve the problem, and convey to correction action (mistake proofing) for improve quality product and production process. Hence, this research will help making case study by proposing some solution to prevent problem and reduce it from occurring.

1.3 The objectives of project

The objectives of this study are as follows:

a) To improve the risk priority number (RPN) in process FMEA using mistake proofing techniques.
b) To identifying, analysing and prioritizing Failure Modes and Effect Analysis of a product and process.
c) To identify potential failures modes and determine its effect before they occur in the process.

1.4 Scope of the study

This scope of the study is focusing on manufacturing industries or production industries. Applying the process FMEA in industries are very important to reduce the risk will produce the benefit in quality, productivity and profit of each companies. Process FMEA can help identify potential failures modes, and then determine its effect before they occur in the process and might go wrong. If something wrong in the process by calculating and evaluate the Risk Priority Number (RPN), they need to design appropriate mistake proofing and detection control into the process that use to improve the RPN. The process FMEA can effectively guide both operator actions prioritize deployment of resource for continuous improvement by using mistake proofing techniques.

CHAPTER 2
LITERATURE REVIEW

A literature review is contains of text of information that purpose to show the point of knowledge. It's more about the theoretical and methodological which is related to the project topic. It also used to determine how this project has been done before jump to the other chapter that needs more understanding about this project. In this literature review, it used to discover all the information that will be used and find out the important thing that need to be pay more attentions on this project.

The literature review for this project had applied mistake proofing jig that used to help improve the Risk Priority Number (RPN) using FMEA techniques at industry. PMEA is one type of FMEA tools or systems that use to identify the problem or mistake which is related to the process of the product. This chapter also explore about the recent study of the FMEA, PFMEA, and Mistake Proofing from the website, article, book and journals. To improve the Risk Priority Number (RPN) by using process FMEA technique and mistake proofing have been chosen to complete this project.

2.1 FMEA (Failure Modes and Effect Analysis)

FMEA used to identify potential failures modes and their causes, and also the effect of the failures on the system at the product and process. It also helps to assess the risk that link to each other with the identified failure modes, effects, causes and prioritize for improvement action. Besides that, FMEA can carry out correction action to address the most serious processes by identify the critical characteristic of the product and process, and also can rank order potential in design and process. It has been used in industry in order to help people focusing on the eliminating product and process problem in addition to avoid the problems from occurring. Furthermore, FMEA is an engineering analysis done by an expert team of subject matters with conscientious analyses product design or manufacturing process in the product development process. It is discovery and correcting problem or weaknesses at the product before the product gets in to the hand of customer. An FMEA should be the manual guide to the development of the industries or company as an action that will minimize risk that related with the system, product, process, and others to an acceptable stage. A successful FMEA activity will effect to the product cycle life, and also it will result significant improvement to reliability, safety, quality, delivery, and cost.

2.1.1 Overview of FMEA

The fastest, cheapest and easiest way to build something is doing it properly the first time. According to Fiorenzo Franceschini and Maurizio Galetto (2001), the life cycle of a product or part is analysed by an inter functional work team while Khalid S. Mekki (2006) describe FMEA as a famous tools that allow to prevent a product or a process failure before they occurs. It used to minimize failure cost by identifying early in the product development cycle. It is a proactive tool which is commonly used its Engineering and Medical field. It is widely used in new product design, process and service that identify failure mode and determine its effect before they occurs.

According to the John Wiley (2012), FMEA is a tool that exists in the larger framework of quality and reliability process. If one's approach to achieving quality and reliability is sound, then it will properly guide the use of the FMEA tools while Sally (2013), FMEA is systematic approach that applies the method to assist thought process used by engineer to identify failure mode and rate the severity of the effect.

Failure mode and effect analysis (FMEA) has been widely used for inspecting potential failures in product, processes, design and service. An important output of FMEA is determination of the risk priorities of the failure modes using the risk priority numbers (RPNs) by multiple the ranks of the three element of risk namely Severity (S), Occurrence (O), and Detection (D) of each failure mode to be exactly evaluated (Wang, 2009). Furthermore, the basic steps are to identify the root causes and potential problem that could occur and then derive which can direct improvement effort to the areas of greatest concern. Action are then undertaken to reduce risk presented by failure mode (Crites, J. W. and Kittinger, S. W., 2009)

FMEA use to assess the failure effect on the system reliability based on a single or one failure. Fortunately, Pickard et al. suggest a method to incorporate multiple failures mode in to single one, which is open the possibility for us to analyze system considering multiple failure modes at the same times. According to Lee (2000), traditional FMEA sheet only limit to a couple of columns in order to elaborate the overall defect occurs, its cause the source of failures cannot be identified. Thus, analysis process such as FMEA can be used to understand all effect that causes the problem and how to eliminate all problem and error by using this technique. Figure shows the type of FMEA that available in industry.

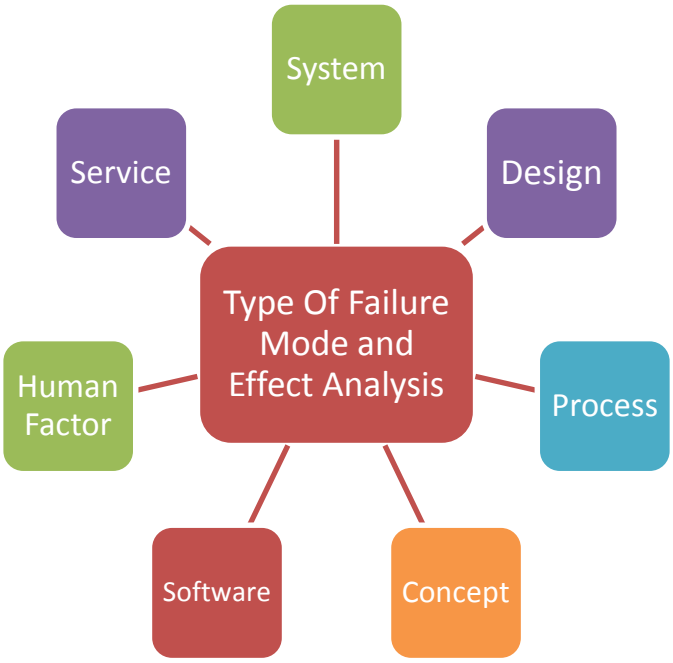

Figure 2.1: Type of Failure Mode and Effect Analysis (FMEA)

2.1.2 History of FMEA

FMEA was officiated by 1949 by the U.S Armed Forces by the introduction of the Military Procedures document (MIL-P)-1629, "Procedures for Performing a Failure Mode Effect and Criticality Analysis." The objective was to classify failures "according to their impact on mission success and personnel/equipment safety." It was later accepted in the Appollo space program to reduce risk due small sample sizes. The utilization of FMEA gained momentum during the 1960s, with the push to place a man on the moon and return him safely to the earth. In the late 1970s, the Ford Motor Company introduced FMEA to the automotive industry for safety and regulatory consideration after the Pinto affair. The also use it to improve production process and design product. In the 1980s, the automotive industry began implementing FMEA by standardizing the structure and method through the Automotive Industry Action Group. Even though developed by the military, the FMEA method is now widely used in a variety of industries including automotive, plastic, semiconductor processing, foodservice, software, and healthcare and others.

2.1.3 FMEA Worksheet

FMEA uses a tubular method of presenting data, its means the content of the analysis is visually displayed in a column and row in worksheet. Before starting with an FMEA, it is very important to create FMEA worksheet that contains the important detail information about the system. The example of the FMEA worksheet is shown in the figure:

Table 2.1: Generic FMEA worksheet

Items	Function	Potential Failure Mode	Potential Effects Of Failure	Severity	Potential Causes Of Failure	Occurrence	Current Design Controls (Prevention)	Current Design Controls (Detection)	Detection	RPN	Recommended Actions	Responsible Person / Target Completion Date	Action Taken / Effective Completion Date

2.1.3.1 Items

An “items” is the important thing that needs to focus of the FMEA system or project. For a System FMEA, this is the system itself. For Design of FMEA, this is the component under analysis and for the Process FMEA; this is normally one of the certain steps of the assembly process or manufacturing process under analysis, to be presented by an operation description.

2.1.3.2 Functions

A “function” is what the process or item is aimed to do, normally to a given standard of requirement. For Design FMEA, this is the main purpose or design intend of the item and for Process FMEA, this is main purpose of manufacturing process along with necessary requirement. There can be many functions for each operation or item. In the worksheet, the word of the function and standard of requirement can be combines together in same column (Function).

2.1.3.3 Failure Mode

A “Failure mode” is the way in which item or operation potentially fails to meet or deliver the aimed function and related requirement. The definition of failures modes may include failure to perform, poor performance of the function, and performing undesired function. The term “failure mode” has combine two words that each word has interesting meaning. The Concise Oxford English Dictionary defines the word “failure” as the act of ceasing to function or the state of not functioning while the word “mode” is defined as a way in which something occurs. Combining both of the words can define the way which is item does not meet the requirement.