UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Assessing a System Reliability: A Case Study in Manufacturing Company**

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

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I hereby, declared this report entitled "Assessing a System Reliability: A Case Study in Manufacturing Company" is the results of my own research except as cited in references.

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APPROVAL

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

……

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ABSTRAK

Dalam bidang pembuatan, persaingan global yang sengit dan perubahan pasaran yang pesat memerlukan pengeluar untuk bersaing dalam keadaan yang sangat kompetitif ini. Sehubungan itu, mengekalkan peralatan mesin dalam keadaan yang sangat dipercayai adalah satu kemestian untuk menyesuaikan dan memenuhi citarasa pelanggan dalam persekitaran perniagaan yang sentiasa berubah. Oleh itu, tujuan kajian ini adalah untuk meningkatkan kebolehpercayaan sistem di sebuah syarikat pembuatan. Selaras dengan keperluan ini, kebolehpercayaan setiap mesin hentak mekanikal dalam pengeluaran 'lower rail' di Kilang A diukur dan dinilai. Pemilihan pengeluaran 'lower rail' adalah berdasarkan kepada kekerapan kerosakan yang berlaku dalam pengeluaran tertentu melalui temu bual dengan Jurutera Proses.

Dalam usaha untuk mengukur dan menilai kebolehpercayaan, Analisis Data Hayat digunakan di mana nilai kebolehpercayaan boleh ditentukan. Walau bagaimanapun, terdapat had yang perlu dipertimbangkan di mana hanya empat mesin hentak dinilai dan proses mengecat dikecualikan kerana dilakukan tanpa penggunaan mesin. Daripada objektif pertama ini, mesin yang menyumbang kepada kebolehpercayaan yang rendah dalam sistem tersebut dikenalpasti. Kemudian, Analisis Mod Kegagalan menggunakan perisian Minitab digunakan untuk mengenal pasti punca utama kegagalan yang menghalang mesin untuk melaksanakan fungsi yang diperlukan. Kedua-dua hasil daripada dua objektif ini membantu dalam menyarankan penambahbaikan dengan mempertimbangkan konfigurasi sistem dan punca kegagalan dalam mencapai kebolehpercayaan sistem yang lebih baik. Ianya dapat disimpulkan bahawa projek ini dapat membantu syarikat mengenal pasti komponen yang tidak boleh dipercayai seterusnya memaksimumkan kebolehpercayaan sistem dalam pengeluaran.

ABSTRACT

In manufacturing field, the intense global competition and rapidly changing markets require manufacturers to struggle with these highly competitive circumstances. Consequently, maintaining the machinery equipments in a highly reliable condition is a must to adapt and satisfying the customer preferences in an ever-changing business environment. Therefore, the purpose of this study is to improve the reliability of a system in a manufacturing company. Regarding to this requirement, the reliability of each mechanical stamping machine in the production of lower rail at Factory A are measured and assessed. The selection of lower rail production is based on the frequency of breakdown that happen in certain production through an interview with the Process Engineer.

In order to measure and assess the reliability, Life Data Analysis is used where reliability value can be determined. However, there is a limitation that needs to be considered where only four stamping machines are assessed and the painting process is excluded since the process is done without the use of machine. From this analysis, the machine that contributes to low reliability of the system is identified. Then, Failure Mode Analysis using the Minitab software is used to identify the main cause of failure that prevents the machine to perform its required function. Both findings from these two objectives help in suggesting the improvement by considering the system configuration and cause of failure in achieving better reliability of the system. It can be concluded that this project can help the company to identify unreliable component which in turn maximize the reliability of the system in production.

DEDICATION

To my beloved family, my supportive friends and lecturers whose have guided and inspired me in completing this project successfully. Without their love and support, this project would not have been made possible. I love you all.

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Bismillahirrahmanirrahim. With the name of Allah the most Gracious and the most Merciful.

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Lastly, I also would like to thank all my friends especially to my classmates for their kindness and supports in given such a great ideas and help. Also, to who are directly or indirectly involved in completing this project report.

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AD	-	Anderson-Darling
ANN	-	Artificial nueral network
FYP	-	Final Year Project
LDA	-	Life Data Analysis
ML	-	Maximum likelihood
MTTF	-	Mean Time to Failure
pdf	-	Probability distribution function
RBD	-	Reliability Block Diagram
SOP	-	Standard of Procedure

CHAPTER 1
INTRODUCTION

This chapter gives an overview about the project entitled "Assessing a System Reliability: A Case Study in Manufacturing Company". The background of project, problem statement, objectives, and scope are discussed in the succeeding segment. Besides, structure of the report is stated to briefly explain the content of each following chapter.

1.1 Background of Project

This project is done to assess the system reliability of stamping machines at a selected manufacturing company in which reliability of each equipment as well as the reliability of the system under study is measured. The causes of failure that prevents the equipment to perform its required function will be identified. In turn, suggestions are devised to improve the reliability of the system.

Sanseverino & Ramirez-Marquez (2014) indicated that the reliability of systems depends on system configuration, service function and the reliability of system components. Generally, the word reliable usually means "dependable" or "trustworthy". For instance, reliability has to do with quality of measurement. Reliability can be defined as quality over time and therefore in reliability improvement experiments, the performance of the product over time needed to be studied as opposed to just measuring the quality at a fixed point of time (Khandelwal, 2011). The high expectation from the manufacturer to produce reliable and safe products in line with the function to ease

human's daily activities and meet customer requirements are not surprising in the recent world where enhancement of technology occur. In fact, fierce global competition and more rapidly changing markets have created a complex and less predictable environment. In order for manufacturers to be able to struggle with this highly competitive situation, a company has to maintain their machinery equipment in highly reliable conditions. In this case, a system reliability improvement becomes a critical issue in the framework of satisfying ever-changing customer preferences in an ever-changing environment. In order to achieve the purpose of improving system reliability, high reliability unit should be made without waste and low reliability unit can be improved (Wang et al., 2014).

In line with the current situation, manufacturers have always tried and strived to plan, design, manufacture and operate system that are relatively free from failure. This project helps in measuring the reliability of the system by using quantitative assessment. Generally, this type of assessment can be used for two particular purposes, either assessment for past performance or prediction of future performance. Most of the manufacturing companies or organizations frequently assess the reliability of past performance and neglect the future prediction performance. However, to predict the future performance, knowledge from the past is required where the need of using statistical data in order to predict the future behavior is also related. In brief, to assess the reliability of the system, the real operating design in which the understanding of how the process works is very important.

The reliability assessment has been done in one of the manufacturing company which is Factory A. This factory is specializing in providing stamping, welding, painting and assembly process for metal automotive components. Factory A has kept on growing from strength to strength until today, which has advanced its capabilities to gain the attention and the trust from high reputation customers to supply for car chassis components, such as seat frame, door hinges, battery clamp and body parts. With the establishment for almost 29 years now, this heritage is set to grow even stronger with the advantage of empowering personnel with good knowledge and expertise. It also believes

that to be a part of an inspired and motivated associates and business partnership with vendors and suppliers can lead to the rapidly advancement as well as making consistent progressions to the equipment and organization. In such commitments, the manufacturing costs can be cut off and stay relevant in an ever-changing business environment. Factory A aimed to satisfy and delighted their customers for the outstanding customer services and deliver value beyond customers' expectations as well as with superb quality of product. To maintain the high reputation and attaining the aim, this project goal is to assist the company in improving the reliability of the system which involved the machinery equipments in stamping process in order to produce the product within the schedule as well as to adapt with the competitive and changing markets with the suggestion for the incoming results.

1.2 Problem Statement

This research emerged based on a reliability concept in which the ability of the subsystems or equipment in a system to perform adequately without failure is the main concern of the company. Traditionally, the configuration of the machine and process arrangement are performed with the assumption that all the machines are completely reliable and accessible at any time, which is never the case in practice. This idea leads to the needs on assessing the reliability of system quantitatively which will be implemented at Factory A. At this factory, the stamping process is the critical stage of production where almost all products will first pass through this process before proceeding to next stages. From an interview and discussion with the Process Engineer, mechanical stamping machines for producing the lower rail are identified to have frequent breakdown. The lower rail is used as an adjuster of the front seat in a car. This has affected the overall production of the lower rail where the production has to stop due to the problem. The series system configuration in this production further complicates the situation in which the production needs to stop even though only one machine in the system breakdown. Figure 1.1 shows the frequency of breakdown for lower rail at Factory A.

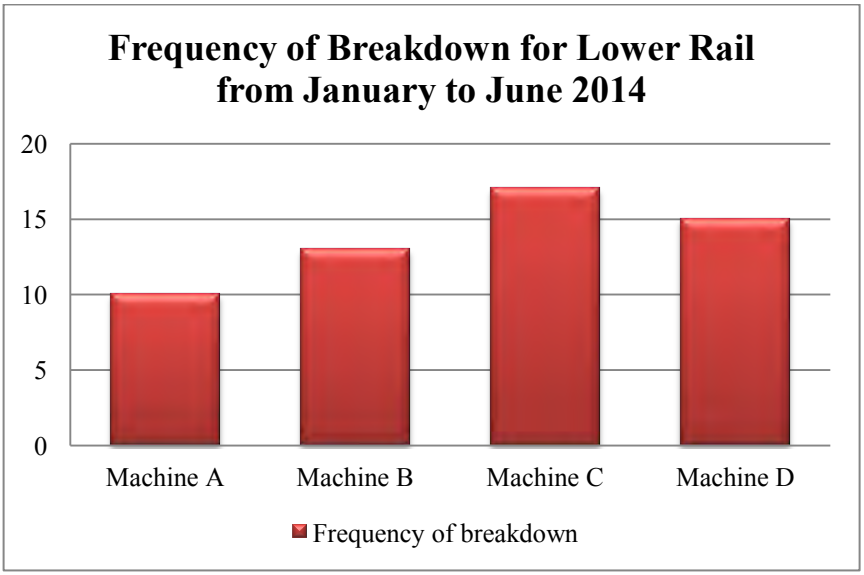

Figure 1.1: Frequency of Breakdown for Lower Rail at Factory A

The failure of any operating equipment or machine in the system configuration to function properly will lead to a change in the state of the system and the quality which clearly affect the reliability performance. Apart from the machine or production stop due to maintenance, the interference in the operating machinery due to breakdown which can be classified as an unplanned activity become the major issue for this project. Frequent stoppage or in other term classified as downtime can cause waste to the company. The production rates are mismatched with the plan schedule in time during the preparation for repairing the machine breakdown. According to Ozkok (2013), machine breakdown can cause delays in the production system where work activities are completed later than the time planned. The delays in workstations will affect the whole production system and lead to deviations from target throughput. This problem will become worse if no further and rapid action taken to solve it which results loss to the company from time to time.

Therefore, to resolve this problem, the quantitative reliability assessment for series system configuration of the selected company is conducted to clarify the life distribution of the equipments. From that, the problems have centered on the down time of equipment where failure rate can be determined. All critical failures associated with the cause of down time machine are then will be identified. Kumar et al. (2007) stated that an analysis of downtime along with the causes is essential to identify the unreliable components and subsystems. Thus, the probability distribution of components in the system can be evaluated based on the data taken in order to assess the system reliability. This study will help the company to identify the unreliable equipments in the system which affect the overall system reliability and swept over the problems in order to achieve better reliability performance.

1.3 Objectives

These are the objectives of this project:

i. To measure and assess the reliability of each stamping machine for production of lower rail as well as the reliability of the system under study.
ii. To identify the causes of failure that prevents the machine to perform its required function.
iii. To devise suggestions for improvement in achieving better reliability of the system.

1.4 Scopes

This project is conducted at the production department of a manufacturing company. The operation of lower rail is studied to identify the process flow and machinery used throughout the production. In this production, four stamping machines performing different sub-process of stamping are involved. After the part has been stamped, it will undergo a painting process and finishing before ready for packaging. However, painting process is done without the use of machine. Therefore, this project is limited to the assessment of reliability of four stamping machines in the system. The scopes of the project are:

i. To review the downtime for each one of repairable stamping machines in a series system configuration for production of lower rail.
ii. To apply appropriate probability distribution in life data analysis to acquire the optimal reliability performance of the series system configuration.
iii. To identify the major cause of failure of the unreliable component in the system for the purpose of reliability improvement.

1.5 Structure of Report

This report is sorted out into five chapters. Chapter 1 introduces the details of the project, which include the project background, problem statement, objectives to be achieved throughout the project and the scope (limitation) of the project under study.

Chapter 2, Literature Review on the prior researchers related to system reliability is provided. This chapter begins with a brief description of stamping machine and process, discussing the reliability concept, purpose of reliability analysis, system configuration, and probabilistic distributions involved in determining reliability. Besides, different ideas and practical approaches will be analyzed and compared to help in assessing the system reliability study of this project.

Chapter 3, Methodology chapter discussed the method employed upon completing the project. This chapter covered the process flow chart, operation and configuration of the system under study. Quantitative approach is used to gather data to obtain reliability performance of the system.

Chapter 4, this chapter revolves in the Result and Discussion where data and outcomes are compiled and analyzed. The data analysis will be demonstrated and discussed further in details in this chapter.

Chapter 5, the Conclusion chapter states the finding of the study and relative importance of the system applied in the company. In addition, suggestions for future improvement of the project are devised in the chapter.

CHAPTER 2
LITERATURE REVIEW

This chapter describes briefly about the machine and process involved in the project. It also summarizes the current state knowledge towards the system reliability assessment. The concept and purpose of reliability study which reflect the approaches used by previous researchers on related topics are highlighted. Related issues and consideration regarding assessment of reliability for particular system such as system configuration are reviewed from past studies for better planning of the project. Besides, brief information on the method on assessing the reliability is also included in this chapter.

2.1 Function of Mechanical Stamping Machine

Mechanical stamping machine functions as the signature pieces of shop floor equipment in a stamping operation. It is metalworking machine tool used to cut metal or presses work by deforming it with a die. In most mechanical stamping machine, flywheel that is driven by motors will store the vitality (energy) that is then exchanged to ram motion which in turn utilizes the force of a moving ram to transmit force or an amount of tonnage to specific tooling in order to achieve the final product's shape. The final product or stamped components are made between the two parts whereby the upper and lower of a press tool are called die. This machine operates by giving vitality to compel a ram downward and thus successfully providing force for the stamping dies and tooling. Upper die is hooked up to the press ram and this press ram will descend downward toward the lower die. The part material is located between these two die halves. Once

the die halves met, the metal part is cut or shaped. Then, the ram ascends and stamped part is indexed. The stamping cycle repeats according to process requirements.

The sheet metal stamping is the standout amongst the most widely recognized manufacturing processes. A wide range of sheet metal parts is employed in varied industries such as automobile, aviation, electronics, and computers and are formed by different stamping processes such as blanking, forming, piercing, punching, bending and many more. This stamping process is principally utilized for the generation of enormous series of components as a result of the planning and setup of the tools that are troublesome and time intensive. According to Ledoux et al. (2010), one of the foremost important issues within the press shop is to get shaped parts with precise geometric characteristics equivalent with the customers' specifications. Thus, the forming tools in blend with the blank are imperative parameters that characterize the final state of the item. At the point where the blank shape and the tools are not ideally composed, it may turns into a defective product (Azaouzi et al., 2012). Significantly, in this process, the die is intended to make the shape and size of the metal parts, more than once and in amounts that will meet the production demands. For this to happen, both force (load) and exactness are obliged to accomplish the repeatability and tolerance demands for the last stamped and assembled parts. Therefore, the reliable stamping machine is needed to ensure the production demands can be fulfilled just in time.

2.2 Concept of Reliability

System reliability studies help in better understanding of functional behavior of the equipment or component in the system itself. It plays a critical role in deciding the overall performance of the manufacturing framework. Wilson et al. (2011) stated that expected performance of system over time depending on the ability to gauge framework of system reliability with an applicable measure of related uncertainty. The most generally acknowledged meaning of reliability is the probability of an item to perform an obliged function under indicated conditions for an explicit period of time. Similarly,