FORECASTING HIGHLY IRREGULAR DEMANDS

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management)

by

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Forecasting Highly Irregular Demands**

SESI PENGAJIAN: **2010/2011 Semester 2**

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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). The member of the supervisory committee is as follow:

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ABSTRACT

The author presents the case of an Independent Power Producer (IPP) facing the problem of managing the inventories of hundreds of different items. A key feature of the problem is that the demand for the vast majority of items is intermittent. This project address the problem of forecasting intermittent demand in which most of the time the demand is zero, however, in some periods the demand is very large. This problem is faced by almost all companies that store and uses spare parts for their preventive and breakdown maintenance works. This project intends to investigate the use of Simple Exponential Smoothing (SES) and Moving Average (MA) as forecasting models that capable of solving the forecasting problems of intermittent demand. A comparison works among the two models will be carried out using a real data collected from YTL Power Services Sdn Bhd (YTLPS) in Paka, Terengganu.

ABSTRAK

Penulis menyediakan kes ‘Independent Power Producer’ (IPP) yang menghadapi masalah pengurusan persediaan ratusan item yang berbeza. Ciri-ciri utama dari masalahnya adalah bahawa permintaan untuk sebahagian besar barang adalah jarang-jarang. Projek ini mengatasi masalah permintaan itu di mana sebahagian besar waktu permintaan adalah sifar, namun, dalam beberapa tempoh permintaan sangat besar. Masalah ini dihadapi oleh hampir semua syarikat yang menyimpan dan menggunakan barang simpanan untuk kerja-kerja penyelenggaraan. Projek ini bertujuan untuk menyiasat penggunaan ‘Simple Exponential Smoothing’ (SES) dan Moving Average (MA) sebagai model peramalan yang mampu menyelesaikan masalah peramalan permintaan itu. Perbandingan di antara kedua-dua model akan dilakukan dengan menggunakan data yang dikumpulkan dari YTL Power Services Sdn Bhd (YTLPS) di Paka, Terengganu.

ACKNOWLEDGEMENT

First of all I would like to thank to Allah for my successful completion in this Final Year Project II (FYP II) report. The big thanks dedicate to both of my supervisors, Prof. Madya Dr. Khaled and Mr. Nor Akramin Mohamad for their support, guidance and time to help and give me the best for my Final Year Project. Unforgotten, thanks to all personnel from Faculty of Manufacturing Engineering for their attention in preparing form for this FYP II.

Thanks to YTL Power Service (YTLPS) for their cooperation in data collection especially to Mr. Nik Sulaimi, the technician for inventory department and Mr. Kamaruddin, the mechanical engineer. Last but not least, thanks a million to my uncle and family for their support and advice in completing this report.

DEDICATION

I dedicate this final year project (FYP) report to my parent, Hjh Rahimah Yusoff and Hj Wan Mansor Wan Hamat, my uncle Wan Mohammad Wan Hamat and my Supervisors Prof Madya Dr Khaled Omar and Mr. Nor Akramin Mohamad.

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LIST OF ABBREVIATIONS

UTeM	-	Universiti Teknikal Malaysia Melaka
YTLPS	-	YTL Power Services
TNB	-	Tenaga Nasional Berhad
SES	-	Simple Exponential Smoothing
MA	-	Moving Average
MAPE	-	Mean Absolute Percentage Error
MAD	-	Mean Absolute Deviation
MSE	-	Mean Squared Error
GDP	-	Gross Domestic Product
EMA	-	Exponential Moving Average
FYP I	-	Final Year Project I
FYP II	-	Final Year Project II
Alpha (α)	-	Smoothing Constant
n	-	Period
RTPM	-	Real Time Performance Management
PTFE	-	Polytetrafluoroethylene

CHAPTER 1

INTRODUCTION

Accurate forecasting of demand is important in inventory control (Buffa & Miller, 1979; Hax & Candea, 1984; Silver, Pyke, & Peterson, 1998), but the intermittent nature of demand makes forecasting especially difficult for service parts (Swain & Switzer, 1980; Tavares & Almeida, 1983; Watson, 1987). Similar problems arise when an organization manufactures slow-moving items and requires sales forecasts for planning purposes.

This chapter is attempts to provide general information relevant to this research. Specifically, this chapter presents background of study in Section 1.1, Section 1.2 presents the Problem Statement, and Section 1.3 explains the Research Objectives. Section 1.4 shows the Research Scope, Research Methodology Flow Chart is explained in Section 1.5 and Section 1.6 showing the Solution Methodology. Addition in Section 1.7 is the organization of the overall report.

1.1 Background of Study

Because future demand plays a very important role in production planning and inventory management, fairly accurate forecasts are needed. The manufacturing sector has been trying to manage the uncertainty of demand for many years, which has brought about the development of many forecasting methods and techniques (Makridakis and Wheel right, 1987). Statistical methods, such as exponential smoothing and regression analysis, have been used by decision makers for several decades in forecasting demand. In addition to 'uncertainty reduction methods' like forecasting, 'uncertainty management methods' such as adding redundant resources have also been devised to cope with demand uncertainty in manufacturing planning and control systems (Bartezzaghi et al., 1999). However, many of these uncertainty reduction or management methods may perform poorly when demand for an item is lumpy that is, characterized by intervals in which there is no demand and, for periods with actual demand occurrences, a large variation in demand levels. Lumpy demand exists in both manufacturing and service environments, including items such as heavy machinery or spare parts (Willemain et al., 2004). For instance, lumpy demand has been observed in the automotive industry (Syntetos and Boylan, 2001, 2005), in durable goods spare parts (Kalchschmidtet al., 2003), in aircraft maintenance service parts (Ghobbar and Friend, 2003), and in telecommunication systems, large compressors, and textile machines (Bartezzaghi et al., 1999), among others.

1.2 Problem Statement

YTLPS is a large power plant that provides electrical power to support Tenaga Nasional Berhad (TNB) as a supplier for electrical power located in Paka, Terengganu. YTLPS have a large spare parts inventory stores in which hundreds of thousands of spare parts are kept for preventive and breakdown maintenance activities.

The problem facing by the spare parts inventory manager is that some of the spare parts have the characteristics of intermittent (irregular) demand and are very hard to forecast. There is software used by the manager to record the amount or quantities of spare parts movements (withdrawal and arrived new spare part). As a result, the manager knows how much the quantity of spare part available in the store. But, there is no systematic forecasting system to predict future demand of the spare parts. This leads to problem of high inventory levels for certain spare parts. Sometimes, there is no spare part available when mechanical maintenance staff needs it. At the same time, inventory manager have to order the spare part and it takes time and that causes planning of repair tasks to be complicated and less efficient. Therefore, a development of an efficient forecasting system must be adopted by YTLPS.

1.3 Research Objectives

The main objective of this project is to determine the future demand of the spare parts with intermittent (irregular, slow moving) demands and as a result, the following are the project objectives.

Specific objectives are:

i) To analyze the demand data collected from YTLPS.
ii) To develop and use Simple Exponential Smoothing (SES) as a forecasting model to predict future demand for the slow moving items.
iii) To develop and use Moving Average (MA) as a forecasting model to predict future demand for the slow moving items.
iv) To conduct a comprehensive investigation to compare among the models detailed in (ii) and (iii) above.

1.4 Scope of Study

This project only concerned with two forecasting models which are Moving Average (MA) and Simple Exponential Smoothing (SES). This project is mainly focuses in SES and MA and not concerned with other quantitative forecasting methods for predicting items with irregular demand. The actual withdrawal (demand) of spare parts collected by the author from the inventory department, at YTLPS for the period between 1998 until 2011 will be used to carry out the work described in this project.

1.5 Flow Chart of Research Methodology

Figure 1.1 shows the flow chart of research methodology of this research. Starting with define problem statement, objectives and scope of study. Then, study the literature review. Followed by data collection and then develop forecasting models. Testing and result analysis are discussed and lastly report the finding.

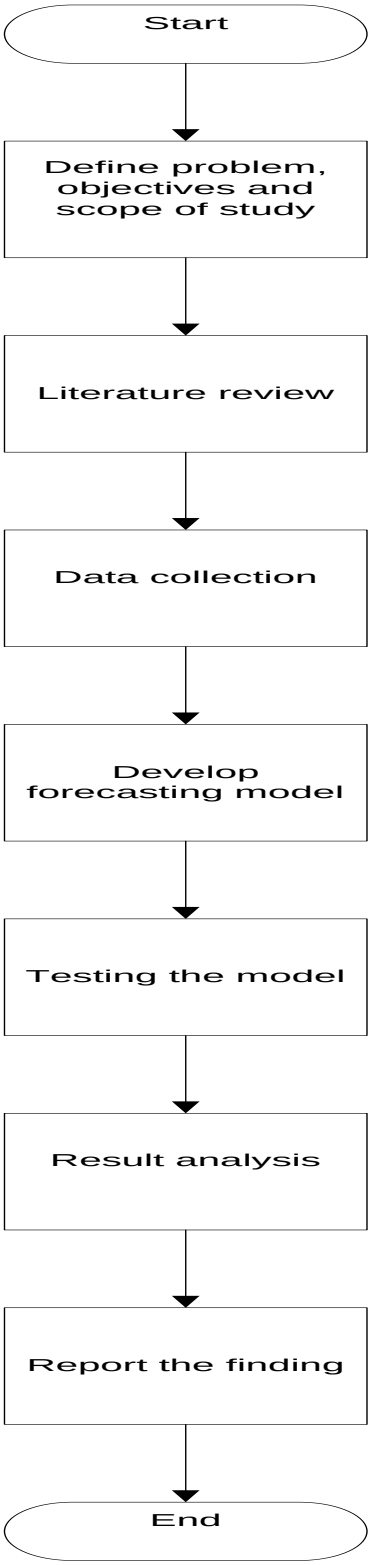

Figure 1.1: Research Methodology Flow Chart

1.6 Solution Methodology

The solution methodology for this research is generally illustrated in Figure 1.2. Once the data on previous demand is collected, analyze them. Then, develop the forecasting by using two forecasting methods which are Moving Average (MA) and Simple Exponential Smoothing (SES). The Mean Absolute Deviation (MAD), Mean Squared Error (MSE) and/or Mean Absolute Percentage Error (MAPE) are used to determine forecast accuracy. Many variation of n and α will be use to select the best of those two forecasting methods. Then, compare the result to select the best technique. Last but not least, reports the finding of project.

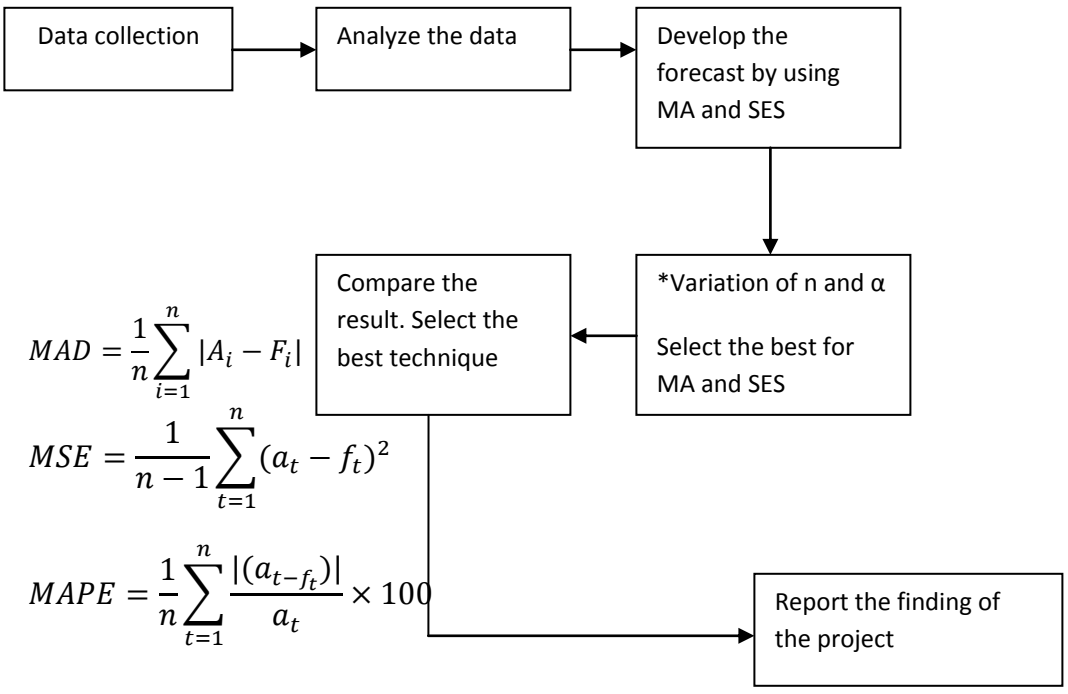

Figure 1.2: Solution Methodology

1.7 Organization of This Report

This report is organized by 3 chapters as followed:

Chapter 1 explained about the introduction of this research. Also define what is forecasting and why it is called as irregular demand. This chapter includes background of study, problem statement, research objectives, and scope of study, research methodology and solution methodology.

Chapter 2 revises the literature review of this research. The theories related to study were explained in this chapter. The background of forecast, features common to all forecasts, elements of a good forecast, steps in the forecasting process and forecasting accuracy were included. Also contains in this chapter are forecasting methods, error in forecasting, and choosing a forecasting technique.

Chapter 3 introduces the research methodology which includes the concept of Moving Average (MA) and Simple Exponential Smoothing (SES). Therefore, the concept of SES and MA were presented in this chapter. Other theories relates to these two concepts are explained.

Chapter 4 discusses the data analysis and explains the overall results and findings for this project. The reason of using certain of period (n) and smoothing constant (α) for different items are discussing in this chapter.

Chapter 5 is the conclusion for the overall findings of this project. A framework for future forecasting system created to help any company that facing problem with large inventory of spare parts like YTLPS.

CHAPTER 2

LITERATURE REVIEW

Forecasting is the process of making statements about events whose actual outcomes (typically) have not yet been observed. A commonplace example might be estimation of the expected value for some variable of interest at some specified future date. Prediction is a similar, but more general term. Prediction of future events and conditions are called forecasts, and the act of making such predictions is called forecasting (Bowerman, O' Connell, *Forecasting and Time Series an applied approach*, 1993).

This chapter introduces the research and forecasting. Start with Section 2.1 by discussing background of forecast. Then, in Section 2.2, explain the features common to all forecast. Section 2.3 discusses the elements of a good forecast. Section 2.4 presents the steps in forecasting process. Section 2.5 presents a vital aspect of forecasting, forecast accuracy. Forecasting methods were presented in Section 2.6. In Section 2.7, the type of forecast is explained. Conclusion for this chapter is in Section 2.8.