IMPACT OF FORECAST MODELING ON COST PERFORMANCE

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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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TAJUK: **Impact of Forecast Modeling on Cost Performance**

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APPROVAL

This report is submitted to 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:

.....

Supervisor

(En. Nor Akramin b. Mohamad)

ABSTRAK

Secara umumya, kebanyakan pentadbiran dan pengurusan industri cenderung untuk mencari dan melaksanakan pendekatan sederhana untuk masalah-masalah operasi yang dihadapi dalam aktiviti harian. Dalam projek ini, penulis merujuk kepada pendekatan sederhana yang difahami oleh pengurus-pengurus. Para pengurus tidak akan merujuk kepada pendekatan yang mereka kurang fahami bagi mengelakkan risiko yang akan ditanggung akibat membuat keputusan yang salah. "*Exponential Smoothing*" dan "*Moving Average*" merupakan kaedah ramalan yang paling umum bagi meramal permintaan pelangan seperti mana dilapor dalam "*Literature Review*". Selain itu, penulis menggunakan inventori model di mana pengurus tidak jelas dengan corak permintaan data-data yang dimiliki. Secara maklumnya, projek ini adalah lanjutan daripada inventori model Lorenzo dan Stefano (2009) tentang sebuah pusat depot di mana data-data sebelum digunakan dan kesan daripada kaedah ramalan dalam kos bagi para pengurus dikenalpasti. Project ini dijalankan melalui contoh kes di mana pengurus mengaplikasikan kaedah ramalan yang popular. Di samping itu, impak daripada kaedah ramalan yang diaplikasikan dikaji melalui senario-senario khas yang disediakan. Selain itu, hasil-hasil simulasi akan diambil sebagai bahan analisis bagi project ini. Pada akhir projek, hasil analysis menunjukkan penentangan yang jelas daripada tanggapan asal. Hasil analysis menunjukkan bahawa makin lemah interaksi antara ketepatan ramalan dengan inventori system menghasilkan prestasi jumlah kos yang memuaskan.

ABSTRACT

As it seems, in real-life industrial situations, management tends to find and implement simple approaches for operational problems that they face in their day-to-day running of business, the author in this regard refer to simple approaches to the approaches that are well understood by managers. It is a known fact in management science that managers will not use approaches that they cannot understand, obviously, due to the risk of making the wrong decision when using an approach they truly not well understood. Exponential Smoothing and Moving Average are two most common and the simplest method to use for demand forecasting, as reported in the literatures. In this project, the author considers an inventory model in which the manager does not know the exact demand behavior. This project present an extension of the central depot inventory model, reported by Lorenzo and Stefano (2009) that allows the author to quantify the historical demand data and the impact of forecast modeling on the expected cost at the manager. This project approach is demonstrated through examples in which the manager employs the commonly used forecast technique and the impact is investigated through the designed scenarios, in addition analyze in term of simulation output measures. At the end of this project, in contrast to the expected finding, result analysis performed that, the weaker the interaction among the forecast accuracy and inventory control system provides the better solution to total cost performance.

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DEDICATION

This research is special dedicated to Professor Dr. Mohamed Khaled bin Omar regards to his kindness and patient in helping the author for this project. Furthermore, it is also dedicated to all those who are kindness in helping the author to the way of success in this project and those who need this project

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CRP	-	Coordinated Replenishment Policy
EOQ	-	Economic Order Quantity
MAD	-	Mean Absolute Deviation
MAPE	-	Mean Absolute Percent Error
MROs	-	Maintenance/ Repair/ Operating
MSE	-	Mean Square Error
ROP	-	Reorder Point
WIP	-	Work In Progress
SES	-	Simple Exponential Smoothing
DES	-	Double Exponential Smoothing
MA	-	Moving Average

CHAPTER 1
INTRODUCTION

This project investigate the impact of forecasting modeling on transportation and inventory carrying cost of an environment that consists of inventory management of a central depot. In this chapter, the following topics will be addressed: overview is first introduced, followed by research problem, objectives, and scope of project.

1.1 Overview

Forecasting is a method to predict the future condition by recognizing the existing condition. It is common in the daily life, for instance, the daily weather forecast. In industrial, generally, they used to forecast the demand for their production lines and inventory level of replenishment. Since forecasting provides an estimated value which is computed from the historical demands, the forecasted demand is closer to the actual demands. In common, an appropriate demand forecasting method (DFM) generated a small variation of forecasted demands from actual, while, a wrong DFM may lead to either overestimate or underestimate of demands consequently. As mentioned by Ralph Snyder (2001), an understanding of key features in demand data is important in the process of simulation development for forecasting and inventory control. Mostly in inventory management, managers encountered only in the accuracy of forecast, however, this project highlighted the main concern of cost performance in term of annual carrying cost and transportation cost. At the end of this project, the author will conclude the finding whether is that a significant difference of total cost by applying difference forecast modeling.

1.1.1 Forecasting

Forecasting is an art and science of predicting future events (Heizer and Render, 2010). In an overview of forecasting, there is classified into two methods: quantitative forecasting method and qualitative forecasting method. Qualitative forecast method is based on educated opinion of appropriate person whereas quantitative forecast method is more to time series analysis such as historical data analysis and component of time series demand. Some examples of qualitative forecast method include Delphi Method, market research, product life-cycle analogy, and expert judgment ("Forecast", 1997). For quantitative forecast method, which is the interested part in this project, there are two parts of concerns. Part 1 is the time-series forecasting modeling which is forecast the new demand based on historical data such as Moving Average, Exponential Smoothing, ARIMA models, etc., while Part 2 is discussed in the components of time-series demand such as trend, average, stationary demand, etc. As mentioned earlier, forecasting is always not an actual value. Therefore, it is important to encounter for its deviation from the actual, or called as error. The performance measures used to determine the forecast accuracy are Mean Absolute Percent Error (MAPE), Mean Absolute Deviation (MAD), and Mean Squared Error (MSE).

In this project, the author concerns in quantitative forecasting. The forecast models applied are Simple Moving Average, Single Exponential Smoothing, and Double Exponential Smoothing. The reason of author using selected forecast modeling is due to its simplicity and popularity used in industrial. Literatures in Chapter 2 reviewed some supportive statements according to author's reason of choosing those forecast modeling. Moreover, the concepts of these forecast modeling is explained in Chapter 4. These forecasting models are then tested by using different component of time series as input demand. These include stationary demand and trend demand. Forecasting accuracy will be concerned as well in analyzing and explaining the resulted impact which will explain in detail in Chapter 6 later.

1.1.2 Inventory Control System

Inventory control system (also called inventory management) is a policy, procedure, and technique employed in maintaining the optimum number or amount of each inventory item. It is applied in both service and manufacturing industry. The objectives of inventory control are to prevent shortages, minimizing the production cost by reducing the stock-holding cost, work-in-progress, and inventory cost. Moreover, the ultimate goal of inventory control system is to achieve 100% demand fulfillment with as low as possible the stock keeping. There are several types of inventory in industry which can be classified into raw material inventory, work-in-progress (WIP) inventory, MROs (maintenance/ repair/ operating), and finished-goods inventory. However, inventory control is one of the most intriguing problems in industrial logistic.

In an inventory control, there are some general terms in inventory control to be introduced. Reorder point, s(t), the inventory level (point) at which action is taken to replenish the stocked item whereas order-up-to-level, S(t), is the optimum level of order quantity. It is noted that the order-up-to-level is not necessitate for every inventory policy, yet, depends on the chosen policy criteria. Next, replenishment lead time, L represents the time between placing and receiving the order and replenishment period (or also called review period), R is meant to the interval period which the order has to be made. Most industry applied the inventory policy into their inventory control system such as fixed period system and fixed quantity system. The concept applied for the former is based on the review period while the later is based on the fixed order quantity. Further description of inventory policy kindly refers to Chapter 4.

Briefly described for the project, the author will develop an inventory control template in MS Excel to determine the order quantity per replenishment period. The inventory control policy used is the fixed period inventory policy where order is made to a maximum level (order-up-to-level) for every review period. Detail explanation for the template will be reviewed in Chapter 5. It is known that the greater the safety stock, the higher the service level, however not every items can be stored for long period such as

the items in this project, canned food. Therefore, in order to keep the inventory at the minimum level, the author decided to keep the service level where two months forecasted demand will be keep as the minimum quantity. This is not only to reduce backorder, it also to standby for any emergency and uncertainty such as stock-out from supplier. However, in the project, backorder is not allowed. Further explanation for the last statement will be discussed in Chapter 5 under model formulation.

Another concern in this project is the total cost development. The cost model, reported by Lorenzo and Stefano (2009) will be used as the model in this project in investigating the impact of forecasting on cost performance. The proposed cost model is associated with the inventory carrying cost and transportation cost. By implementing different forecast approaches may bring to possible effects on inventory control policies. Transportation may be affected as well due to the deviation of forecasted demand resulted from different forecast approach. This final year project will study on the possible impacts resulted from different forecast approach on the cost associated with.

1.2 Problem Statement

As it seems, in real-life industrial situations, management tends to find and implement simple approaches for operational problems that they face in their day-to-day running of business, the author in this regard refer to simple approaches to the approaches that are well understood by managers. It is a known fact in management science that managers will not use approaches that they cannot understand, obviously, due to the risk of making the wrong decision when using an approach they truly not well understood.

In this project, a real case model, reported by Lorenzo and Stefano (2009), is studied to quantify the cost associated with inventory carrying and transportation subject to future demand which the historical data demand pattern is known.

The case involve a company that markets tinned food for hotels, restaurants and catering segment which supply chain network consists of a central depot, three suppliers, and six warehouses. The concern in this final year project is to determine the impact of forecasting modeling on total cost performance, as a consequence of the type of data used in inventory management, of the central depot where stocks received, distributed, packaged, and sent to warehouses and the transportation cost for every replenishment trucks from suppliers. The problem layout is illustrated as in Figure 1.1.

In a simple term, the problem address by this project is to investigate the impact of forecasting modeling on the total cost associated with the inventory and transportation situation depicted in Figure 1.

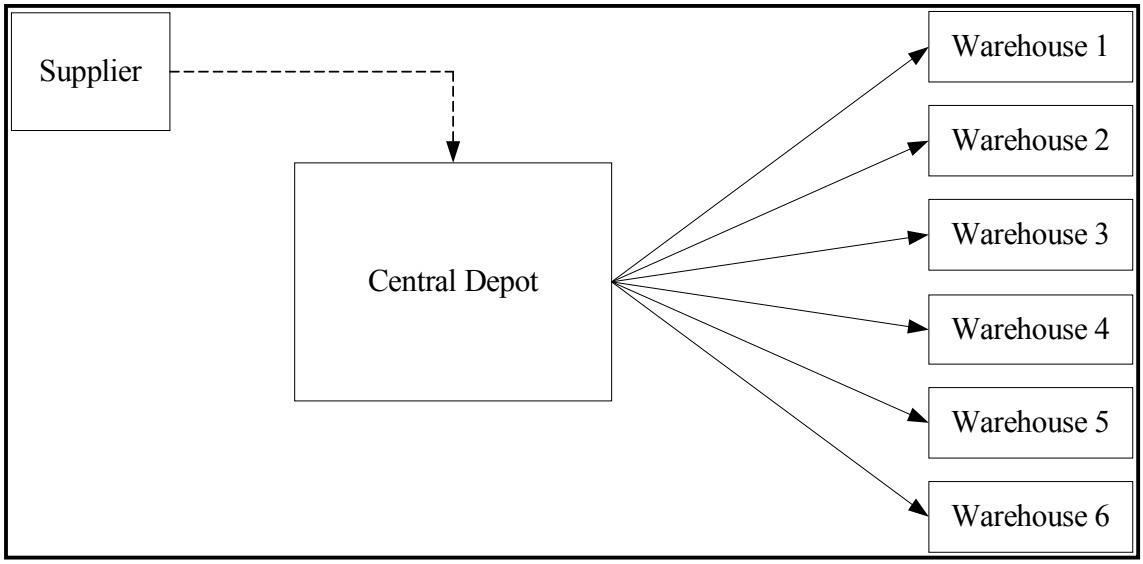

Figure 1.1: The Problem Layout

1.3 Research Objectives

This project is dealing with an industrial situation as described in the problem statement with the ultimate objective to investigate the impact of the forecasting modeling selection transportation and inventory total cost, therefore the objectives of this project are

1. To fully understand the concept of demand forecasting practiced in the industry.
2. To fully understand the inventory policy that commonly used in industry.
3. To develop a mathematical model that can represent the transportation and inventory carrying cost of the case described in the problem statement using MS Excel.
4. To conduct comprehensive computational works to determine the impact of forecasting modeling on the inventory carrying cost and transportation cost.
5. To report the findings.

1.4 Research Scope

The scope of this project is to develop a complex mathematical model that represents carrying inventory costs and transportation costs using MS Excel for the case reported by Lorenzo and Stefano (2009). Moreover, three forecasting modeling approaches will be developed, namely Single Exponential Smoothing, Double Exponential Smoothing, and Moving Average to conducted the investigation of the impact of forecasting modeling on the total cost associated with the inventory carrying costs and transportation costs for the case reported by Lorenzo and Stefano (2009). The component of time series involved in this project is trend and stationary demand. Furthermore, the scope of this project includes a solution methodology that has been developed by the author to conduct the investigation suggested by this project which detailed in this section under proposed solution methodology. It is not in the scope of this project to investigate the impact of other forecasting modeling approaches and or