

CHAPTER II

LITERATURE REVIEW

2.1 Previous Research

Research conducted by Manullang (2003) at PT. Halintar Bahana Prima Leuwikopo Bogor analyzes short-term production planning in particular the procurement of auxiliary raw materials and packaging materials based on historical data on product sales in the past. In this study, analysis uses 2 forecasting methods, namely the Simple Projection Method and the Simple Moving Average. The purpose of this study is that forecasting results can be used to calculate the main raw material requirements, additional raw materials, and packaging materials every month.

Research conducted by Fiona (2006) at PT. Gunungarta Manunggal analyzes the production planning system and controls raw materials for bottled mineral water. In this study, the production strategy used only made to order while the demand for products increased. Therefore, a production planning system is designed with a make to stock strategy, there are three production planning proposals made which are focused on filling inventory until it reaches the minimum stock, the second focuses on filling inventory until it reaches the maximum stock, and the third makes production planning based on the target company. The purpose of this study is to determine the best proposal that can be used by the company.

Abubakar (2017) conducted research at CV. Nur Khairunnisa. This study analyzes material requirement planning can drive a smooth production process and achieve production efficiency. Production activities that will smoothly increase product sales and with production efficiency can result in increased profits. Then this will make an increase in the competitiveness of the company in order to be the capital to compete and survive, so that business continuity will be more assured.

From core of previous research, there are Material Requirement Planning method to identify scheduling of material to reduce cost, to increase profit, analyze and evaluate material. This research will combine 2 methods which are Forecasting and Material Planning Requirements. Forecasting is used to find out the coffee beans need by Couvee coffee. After identifying forecasting of coffee beans, researchers will determine the amount of coffee beans needs. Material Requirement Planning used by the researcher to arrange the scheduling period and choosing supplier that will be implemented in coffee shop.

2.2 Theoretical Background

2.2.1 Forecasting

1. Definition

Forecasting is defined as predicting or estimating a situation in the future based on past and present conditions that needed to determine when an event will happen, so that appropriate action can be taken for future anticipation (Makridakis, 1999). Forecasting is a problem that can cover many fields including industrial business, government, economics, environmental sciences, medical, social, political and financial sciences (Montgomery et al, 2015). Forecasting function is employed as a basis for capacity planning, budgeting, sales planning, production planning and inventory, resource planning, and planning for purchasing raw materials.

Forecasting is an important tool in effective and efficient planning, especially in the economic field. In modern organizations, it is identified that impending situation is not only important to see good or bad but also aims to make forecasting preparations. According to (Yamit, 1999), forecasting is predictions, projections or estimations of uncertain events in the future.

Forecasting is an activity to predict events that will occur in the future. The usefulness of forecasting is seen during decision making. A good decision is a decision based on consideration of what will happen when the decision is made. The use of forecasting techniques begins with exploring the conditions (data patterns) in the past

times in order to develop a model that fits the data pattern assuming that the pattern of data in the past will repeat again in the future. Prediction is needed to provide information as a basis for making decisions in various activities. Good forecasting is forecasting carried out by following good steps or procedures. Basically, there are three important forecasting steps (Makridakis, et al., 1993), there are:

- a. Historical data analysis.
- b. Determine the methods that will be used.
- c. Projecting the data then using the selected methods to consider the multiple factors change

In the business field, forecasting is an important thing that can influence decision making. Forecasting is the basis for long-term planning in business processes. For example, in the financial sector, with forecasting, the finance department can plan the costs to be incurred in the future in the marketing field, forecasting can estimate what products need to be added to production or what products do not need to be reproduced.

Two main things that must be considered in the forecasting process are:

1. Relevant data collection in the form of information that can produce accurate forecasting.
2. The selection of the right forecasting technique will utilize the data information obtained as much as possible.

Basically there are two approaches of forecasting, namely a qualitative approach and a quantitative approach. Qualitative forecasting methods are used when historical data are not available. Qualitative forecasting method is a subjective method. The method is based on qualitative information. With the basis of this information, we can predict future events. Of course the accuracy of this method is very subjective. Quantitative forecasting methods can be divided into two types, causal and time series. Causal forecasting methods include factors related to predicted variables such as regression analysis. Time series forecasting is a quantitative method for analyzing past data that has

been collected regularly using appropriate techniques. The results can be used as a reference for forecasting value in the future (Makridakis. S, 1999).

Various forecasting techniques, including: qualitative technique, extrinsic technique, and intrinsic technic. Intrinsic techniques are projections based on historical data. It based on the assumption that what happened in the past will happen in the future. Various method in intrinsic technique are:

1. Naive method
2. Moving average
3. Weighted moving average
4. Moving average with trend
5. Exponential smoothing
6. Double exponential smoothing

Steps for performing Forecasting:

1. Define forecasting goals
2. Past data plot
3. Choose at least two forecasting methods that are considered appropriate.
4. Calculate the forecasting function parameters for each method
5. Calculate the fitting error for all methods tried
6. Choose the best method, which is the method that gives the smallest error
7. Predict demand for the coming period
8. Verify forecasting.

2. Forecasting Purpose

In general, what is meant by forecasting is an activity that aims to find out or predict events in the future. The purpose of forecasting according to Diana Khairani Sofyan (2013: 15) the main purpose of forecasting is to forecast demand in the future, so that an estimation is approached to the actual situation. Forecasting will never be perfect, but even so the forecasting results will provide direction planning. A company usually uses a

forecasting procedure that is initiated by conducting environmental forecasting, followed by sales forecasting for the company and ending with forecasting market demand.

3. Forecasting Principal

In production activities forecasting the level of demand for a product is needed to anticipate volatile demand. In general, the types of forecasting according to Jay Heizer and Barry Render (2015: 115):

a. Economic Forecast

Planning useful indicators that helps organizations to prepare medium to long term forecasting, which explains the business cycle that predicts inflation rates, the availability of money, the funds needed to build other planning indicators.

b. Technological Forecasting

Long-term forecasting that takes into account the level of technological progress that can launch new products.

c. Demand Forecast

Predict the sales and demand of a company in each period in the time horizon. Sales forecasting that controls production, capacity, and scheduling systems and becomes input for financial planning, marketing, and human resources.

4. Forecasting Methods

Forecasting method is a way of estimating or estimating quantitatively and qualitatively what will happen in the future, based on relevant data in the past. The usefulness of the forecasting method is to estimate systematically and pragmatically on the basis of relevant data in the past. Thus, forecasting is expected to provide greater objectivity.

Forecasting methods provide a sequence and solution to the problem approach in forecasting, so that if the same approach is used for the problem, it will get the basic rationale and solution to the same argument.

There are 2 general approaches to the types of forecasting methods namely qualitative and quantitative. Qualitative forecasting methods are very important where when historical data does not exist, but this method is very subjective and requires assessment by experts. On the other hand quantitative forecasting uses existing historical data. According to Levine, et al. (2002) the purpose of this method is to learn what has happened in the past to be able to predict values in the future.

a) Periodic Series Forecasting Method

Periodic forecasting methods, or commonly referred to as time series, are one of the methods included in quantitative forecasting methods in addition to regression or causal methods. According to Levine et al. (2002) the periodic forecasting method involves projection of future values of a variable based entirely on observations of the past and present of these variables.

b) Smoothing Method

Smoothing method, or commonly called smoothing method, is included in the periodic forecasting method. According to McGee, et al., (1999) smoothing methods have a basis for methods namely simple weighting or smoothing of past observations in a periodic source to obtain future predictions. In smoothing out these historical values, random errors are averaged to produce "smooth" predictions. Among the benefits are low cost, easy to use in its application, and fast in delivery. This characteristic can make it interesting especially when the time horizon is relatively short (less than 1 year). The smoothing method consists of smoothing method, where when doing the same weighting on the values of security in accordance with the conventional understanding of the middle value, and the exponential smoothing method uses different weights for past data, because the characterized weight decreases as exponential from the data points last to the earliest.

2.2.2 Time Series Analysis

Time series data are defined as a set of data at a certain time period. Time series forecasting is forecasting based on past data behavior to be projected into the future by utilizing mathematical and statistical equations. Time series data types according to divided into several types, among others:

- a) The cycle pattern cycle is a series of changes up or down, so that this cycle pattern changes and varies from one cycle to the next. Cycle patterns and irregular patterns are obtained by eliminating trend patterns and seasonal patterns if the data used is in the form of weekly, monthly, or quarterly. If the data used is annual data then all that has to be removed is the trend pattern.
- b) Random Patterns are randomly irregular, so they cannot be described. This random pattern is caused by unexpected events such as war, natural disasters, riots, etc. Because the shape is irregular or does not always occur and cannot be predicted, the pattern of random variation in its analysis is represented by an index of 100% or equal to 1.
- c) Seasonal The seasonal pattern shows a movement that recurs from one period to the next period regularly. This seasonal pattern can be shown by data grouped on a weekly, monthly, or quarterly basis, but for data in the form of annual data there is no seasonal pattern. This seasonal pattern must be calculated every week, month, or quarterly depending on the data used for each year, and this seasonal pattern is expressed as a number. The technique used to determine the value of seasonal patterns is the method of moving averages, exponential smoothing of winter, classical decomposition.

Time series forecasting techniques consist of:

- a) Statistics
 - 1) Moving average
 - 2) Exponential smoothing
 - 3) Regression

- b) ARIMA (Box Jenkins)
 - 1) Artificial Intelligence
 - 2) Simulated Annealing
 - 3) Genetic Programming

Moving averages are included in the time series model which is a quantitative forecasting method using time as a basis for forecasting. To make a forecast, it is required historical data (past) requests.

2.2.2.1 Simple Moving Average

Simple Moving Average or commonly abbreviated as SMA is the simplest Moving Average and does not use inner weighting calculation of the closing price movement.

Simple moving average (SMA) is calculated by taking the average value of the price of a security at a certain time period backwards. This calculation can be taken from the average value of the opening price, closing price, highest price, or the lowest price of a security. There is a formula to calculate the Simple Moving Average indicator:

$$SMA_n = \frac{x_n + \dots + x_2 + x_1}{n} \quad [1]$$

dimana:

SMA_n = Rata-rata bergerak harga saham n hari sebelumnya
 x_n = Harga saham n hari sebelumnya
 x_2 = Harga saham 2 hari sebelumnya
 x_1 = Harga saham 1 hari sebelumnya
 n = Lamanyahari

Figure 2.1 Formula of SMA

2.2.2.2 Linier Regression (*Linier Forecasting*)

Linear Regression is a Statistical Method that serves to test the extent to which the causal relationship between the Variable Factor Cause (X) of the Variable Consequences. The cause factor is generally represented by X or also called the Predictor while the Result Variable is denoted by Y, also called Response. Linear Regression or often abbreviated as LR (Linear Regression) is also one of the Statistical Methods used in production to forecast or predict characteristics of quality and quantity.

The line equation that approaches linear data forms is:

$$Y'(t) = a + b(t)$$

The constants of A and b are determined from the raw data based on the least square criterion. Where a and b can be calculated by the following formula:

$$b = \frac{n \sum_{i=1}^n tY(t) - \sum_{i=1}^n Y(t) \sum_{i=1}^n t}{n \sum_{i=1}^n t^2 - (\sum_{i=1}^n t)^2}$$

$$a = \frac{\sum_{i=1}^n Y(t) - b \sum_{i=1}^n t}{n}$$

Where: $t = \text{time}$
 $Y(t) = \text{Demand Period}$

2.2.3 Material Requirement Planning

Material requirement planning is a method used to control inventory in products with dependent demand. MRP was first discovered by Joseph Orlicky of the J.I Case Company around 1960. Material requirement planning method is Computer Oriented Approach which consists of a set of procedures, decision rules and a set of recording mechanisms designed to describe a Master Production Schedule (MPS). The main objectives of the MRP system are:

1. Ensure the availability of goods, components, products - products for production planning and for delivery to customers.
2. Maintain the possibility of a lower level in inventory.
3. Plan manufacturing activities, delivery schedules and purchasing activities.

2.2.3.1 Input and Output System Material Requirement planning

A. Input MRP

Inventory Status Record (ISR) contains information about all items, components or sub-assemblies for each end item. ISR also contains on hand and on-order arrangements in inventory. Requests for end items are final numbers scheduled for a period of time and listed on MPS. In this system ISR contains the status of all raw materials and products in inventory adjustment. As the minimum amount allowed, the raw material codes, product codes and other - other. Thus, if there is an order from the consumer, then the status of the goods can be known immediately so that the right decisions and actions can be taken.

The MRP system must have and maintain an up-to-date inventory data for each component of the goods. This data must provide accurate information about the availability of

components and all inventory transactions, both those that have occurred and those that are planned. The data include the identification number, the number of items in the warehouse, the amount allocated, the minimum inventory level (safety stock level), the components that are being ordered and the time of arrival, and the procurement lead time for each component (Herjanto, 2008, hal. 280).

B. Output MRP

Hendra & Kusuma (2009) output plan for material needs is information that can be used to control production. From the three main inputs described above, then this system will produce output in the form of order planning information which will be handled by the company. From this information the company can re-order raw materials to suppliers, namely in the form of raw materials that can be used at this time and if necessary can be rescheduled as previously scheduled.

From the information generated by the system, the information will be reprocessed to produce information in the form of:

- a. Planning the next purchase order.
- b. Purchase order that will be carried out.
- c. Rescheduling (reschedule) what has been scheduled.

2.2.4 Basic Step of Material Requirement Planning

According to Hendra & Kusuma (2009) there are four basic steps MRP system, namely:

1. Netting Process

Netting is a calculation process to determine the amount of net needs, the amount of which is the difference between gross needs and the state of inventory (which is in stock and which is being ordered).

2. Lotting Process

The lotting process is a process to determine the optimal order size for each product item based on the calculation of net requirements. The lotting process is closely related to determining the number of components / items that must be ordered or provided.

3. Offsetting Process

This process is intended to determine the right time to make a booking plan in an effort to meet the level of net needs. The order plan is carried out when the required material is reduced at the time of departure

4. Exploding Process

The exploding process is the process of calculating the gross needs of items at a lower level, based on the ordering plan that has been prepared in the offsetting process. In this explosion process the product structure data and Bill of Materials have an important role because they determine the direction of exploding component items.

2.3 Determination of lot sizing

Lot sizing is an activity to determine the number of units to be ordered as defined by Hamming & Mahfud Nurnajamuddin (2014, 36). The decision to determine lot size is the process or technique used to determine lot size (Heizer & Barry Render, 2014, hal. 654).

Heizer & Barry Render (2014, 654) states that the decision to determine lot sizing is a decision made about how much to order or make. There are various ways to determine lot size in the MRP system, including Lot for Lot techniques, Economic Order Quantity techniques, and Period Period Balancing, Period Order Quantity (POQ), and Wagner-Whitin Algorithm (WW). Lot for Lot technique is a technique that helps determine the lot size exactly by the net requirement. While the other techniques are based on optimum capacity and cost with the aim of optimization.

2.3.1 Lot for Lot Technique

The Lot for Lot technique produces precisely how much raw material needs are needed. This technique is consistent with MRP's goal of meeting boundary demand requirements. If orders are often economical and just in time inventory techniques are applied, this technique becomes very efficient. Conversely, if the set up costs are large enough or the management is unable to implement just in time, then this technique becomes expensive (Heizer dan Render, 2015:654)

2.3.2 Economic Order Quantity (EOQ)

EOQ technique is a statistical technique that uses an average (such as the average demand for one year). So the EOQ technique is a statistical technique that is actually more suitable for use when demand is free, while MRP is preferred when demand is bound. The production manager must utilize the request information when this information is known, rather than assuming a fixed request (Heizer dan Render, 2015:655). The approach with this technique uses the following equation:

$$Q = \sqrt{2DS H}$$

Where: Q = demand lot size,

D = needs per year,

S = demand cost per order, and

H = holding cost per unit per year

2.3.3 Part Period Balancing (PPB)

The PPB technique is a more dynamic approach to balance setup and storage costs. PPB uses additional information by changing the lot size to describe the next lot size requirements in the future. PPB tries to balance setup and storage costs for known requests. Partial balancing period makes an economic part period (EPP) or part of the economic period, which is a comparison between setup costs and storage costs. (Heizer dan Render, 2015:657).

2.3.4 Period Order Quantity (POQ)

The POQ technique often referred to as the Uniform Order Cycle method, is the development of the EOQ method for a number of unequal requests in several periods. The average demand is used in the EOQ model to get the average number of requests per period and the results are rounded up to integer numbers. The last number indicates the number of time periods covered in each order (Herjanto, 2018:292).

The calculation POQ method using formula as follows:

$$POQ = Q = \sqrt{2SDH}$$

Where: Q = quantity demand of lot size,

D = needs per year,

S = demand cost per order, and

H = holding cost per unit per year

2.3.5 Algorithm Wagner-Whitin (WW)

The WW technique uses an optimization procedure based on a dynamic program model that adds some complexity to the calculation of lot size. This procedure assumes a limited time horizon outside of a situation where there is no additional net need, this procedure gives good results. The aim is to get the optimum ordering strategy for all clean demand schedules by minimizing the total procurement costs and storage costs. Basically, this technique tests all possible ordering methods in meeting the net requirements of each period at the planning horizon so that it always provides optimal answers (Heizer dan Render, 2011:222).

2.4 Roasting Profile of Coffee Beans

There are two kinds of beans which are green beans and roasted beans. Green bean is kind of coffee bean that is produced by farmer and cannot ready serve to customer. The process of green

beans should through roasting process to become roasted beans. The roasted beans cover three kinds of type of roasted process, which are light roast coffee, medium roast coffee and dark roast coffee. According to Oden (2016) there are several profiles of roasted coffee beans, which are:

1. Light Roast Coffee

Light roast coffee produces a light brown color that has no oil on the surface of the beans. The coffee that resulted from this procedure typically has a crisp acidity, a mellow body, and bright flavors.

2. Medium Roast Coffee

Medium roast coffee produces brown color and rarely has an oily surface. The coffee will have a medium acidity and body, as well as a rounded flavor profile.

3. Dark Roast Coffee

Dark roast coffee has dark brown color and often has an oily surface. The coffee will have a low acidity, heavy body, and tend to reveal deeper, darker flavors. This roast profile usually called by full-city roasted beans.

Roaster and coffee geek recommend around 3 – 5 days from the roast date. Coffee in that time is considered the best for consumption because the degassing process in coffee has been completed. The rest in the rate of coffee beans is all natural substances and good substances that are fully loaded. Some experts state that this ideal duration is still considered good enough to the 32 – 35 day deadline.

Coffee should be stored in a canister or tightly closed glass container (if possible, airtight) while the seal on the coffee packaging is opened. Because the freshness of coffee will decrease once the coffee is exposed to air.

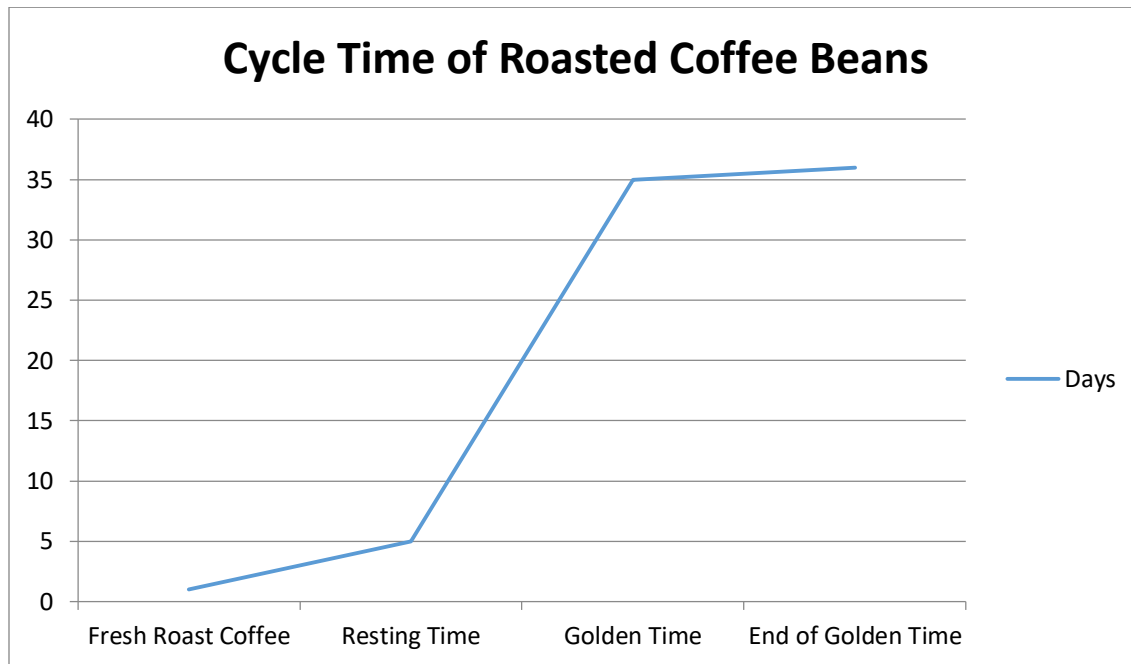


Figure 2.1 Cycle Time of Roasted Coffee Beans

From the first day of roasted beans has been released, the coffee beans cannot directly be served to the customer, because the coffee bean needs time to release the carbon dioxide inside of coffee. This process called by degassing process or coffee beans resting time. This process needs time around 5 days from the roasted beans released by roasting machine. After that the coffee beans does not fulfilled much carbon dioxide gas, so the coffee beans has optimum an aroma, taste and body, which called by golden time. The coffee shop should serve the coffee beverage to the customer only by using coffee beans during their golden time. It takes about 30 days to serve the perfect cup of coffee to the customer. After 30 days the coffee beans no longer have perfect aroma, taste and body, this moment namely the end of golden time.