Planning of Master Production Schedule at PT Semen Padang

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Abstract. PT. Semen Padang is a company that produces cement. In producing cement, of course we need a master production schedule to plan and produce outputs related to quantity and time periods. In other words, the master production schedule is a plan that identifies the quantity of certain items made by a company. The subject studied in this case was PT Semen Padang, where PT Semen Padang has not used precise calculations based on the rules and formulas for making a master production schedule so that the production department does not have a reference in conducting the cement production process. In this research, what will be done is making the master production schedule for 2017 using his historical data three years earlier. From observations made precisely in the Production Planning and Evaluation (PEP) section, that the company's production planning is good enough. Every day the company always takes stock data from every factory in Indarung, starting from Indarung II / III, Indarung IV, V, and Indarung VI. The method used by the company is a calculation based on historical data taken every day, and with estimates based on stock data taken every day.

1. Introduction

Production planning is an activity relating to the determination of what must be produced, how much is produced and what resources are needed to obtain a predetermined product. [1] Inventory is a company's assets in the form of material. Inventory can be found both in raw materials (raw material) and finished goods (finished good) in a company [2]. The main function of inventory is to ensure the smooth fulfillment mechanism of goods in accordance with needs so that the company that is managed to achieve optimal performance. According to Gaspersz in Saputro, forecasting is a business function that seeks to estimate the sale and use of products so that products can be made in a fixed quantity [3]. The purpose of forecasting is to determine the number of product requests in the future [4]. The forecasting consists of several stages, especially if using quantitative methods. The steps are as follows:

- Defining forecasting goals.
- Make a scatter diagram (plot data).
- Choosing the right forecasting model.
- Forecasting.
- Calculating forecast errors.
- Choose the forecasting method with the smallest error [5]
Various previous studies regarding the arrangement have been many previous researchers, such as the research conducted Rasbina et al stated that with the existence of a MPS that functions as basis in determining the schedule of the operating process on the factory floor, and the schedule of resource allocation power to support the schedule of product delivery to consumers the company can carry out production activities in a planned and controlled manner. Therefore companies need MPS planning in order to control production integrated manner. On the off chance that the consequences of QC tests can't satisfy the acknowledgment models, the aftereffects of examination of the entire arrangement of the estimations on that day must be eliminated or should be re-dissected, and an incomplete or full re-approval of the strategy considered [22].

The method used in problem solving is by conduct the preparation of MPS in an effort to meet the product delivery schedule to customer. The results of the MPS compilation show that all products ordered can be completed in accordance with the time set by the consumer or in other words. There were no delays in completing orders on the production floor and also can obtained the rough capacity plan required by the company. MPS sets the level of finished product inventory so that it will affect inventory management company. With the existence of MPS, it is hoped that it will not the stop of the production process on the factory floor. Lack of raw materials in a company, the production process will stop. [6]

2. Literature Review

The Master Production Schedule (MPS) is a statement about the final product (including replacement parts and parts) from a manufacturing industry that plans to produce output in terms of quantity and time period, the master production schedule disaggregates and implements the production plan [7]. MPS is based on aggregate production planning and is a key link in the production planning and control chain. MPS deals with marketing, distribution plans, production planning and capacity planning [8]. There are several methods that can be used in preparing the master production schedule. The methods that can be used include permanent labor methods, changing labor methods, subcontracting methods, and transportation methods [9].

In making a production plan, of course the basic framework needed as a reference in making it. The basic framework of an integrated production planning and control system and information flow between sub-systems is as shown in Figure 1 below [10].

![Figure 1. Production planning and control system framework](image-url)
In addition to the framework, there are also characteristics in production planning. The properties are timed, tiered, integrated, sustainable, measurable, realistic, accurate, and challenging [11].

Forecasting is a process for estimating several needs in the future which includes the needs in terms of quantity, quality, time, and location needed in order to meet the demand for goods or services [12]. Render and Heizer define forecasting as the art and science of predicting future events [13]. The aim is to predict future requests, so an estimate is approaching the actual situation. Patterns in forecasting are used to support the selection of forecasting methods that will be used to produce good forecasting. There are two forecasting models, namely time series and causal [14].

According to Kusuma inventory is defined as goods that are stored for use or sale in the period of arrival [15]. While according to Soemarso S.R, inventories are goods owned by the company for resale. Inventories occur when the amount of material or goods held [16].

3. Research Methodology

In producing cement, of course we need a master production schedule to plan and produce outputs related to quantity and time periods. In other words, the master production schedule is a plan that identifies the quantity of certain items made by a company. The subject studied in this case was PT Semen Padang, where PT Semen Padang has not used precise calculations based on the rules and formulas for making a master production schedule so that the production department does not have a reference in conducting the cement production process. To solve this problem, it is necessary to prepare a master production schedule using historical data and forecasting methods.

3.1. From Production Plan to Master Production Schedule

Production plans and master production schedules differ in their precision. Production plans are “macro” plans, while MPS are “micro” plans. Production planning is for preparing resources to accomplish business objectives. Resource requirement planning is used to reconcile business objectives with the resources available. MPS is the schedule of end item production. It is a decision of manufacturing actions subject to the constraints of capacity.[17]

PT Semen Padang Indarung has 6 factories, namely Indarung I, Indarung II, Indarung III, Indarung IV, Indarung V, and Indarung VI. For Indarung I specifically produces cement according to custom or demand with high quality and the only machine operating is a cement mill, while for Indarung II-VI produces from raw mix to final cement. From observations made in the Production Planning and Evaluation (PEP) section, the company's production planning is good enough. Every day the company always takes stock data from every factory in Indarung, starting from Indarung II / III, Indarung IV, V, and Indarung VI.

What will be done in this report is to create a master schedule for clinker production in 2017. The analyzed factories start from Indarung II to Indarung VI. The data used are secondary data obtained from the production planning report in the Production Planning and Control section. Primary Data is the type and source of research data obtained directly, meanwhile secondary data is a source of data from research conducted by researchers who are not directly through participating media (obtained or verified by other parties) [18].

Sampling technique is a way to determine the number of samples in accordance with the sample size that will be used as the actual data source, taking into account the characteristics and population distribution in order to obtain a representative sample [19]. Sampling technique is a sampling technique [20].

| Month   | RKAP Plan and Realization of Each Indarung Production | Production Capacity (Ton) |
|---------|------------------------------------------------------|---------------------------|
|         |                                                      | Indarung II | Indarung III | Indarung IV | Indarung V |
| January | Plan                                                 | 58.000      | 52.000       | 142.100     | 229.100     |
|         | Realization                                          | 59.957      | 46.835       | 143.395     | 236.700     |
| February| Plan                                                 | 38.000      | 54.000       | 132.300     | 173.800     |

Table 1. RKAP plan and realization of each indarung production
According to Dalen, several steps that researchers must consider in determining the sample, is: a) Determine the population; b) Finding accurate population unit data; c) Choosing a representative sample; and d) Determine an adequate number of samples [21]. The technique of taking data from historical data in 2014-2016 and using all data without a sample. Data on production planning reports with the realization of production in each Indarung can be seen in table 1.

The data collected is the clinker production request data. The Clinker Request Data Table in Indarung III can be seen in the following table.

### Table 2. Clinker request data in Indarung III for 2014

| Period     | Demand (Ton) |
|------------|--------------|
| January    | 58.600       |
| February   | 49.970       |
| March      | 36.100       |
| April      | 55.104       |
| May        | 57.104       |
| June       | 55.104       |
| July       | 57.104       |
| August     | 57.104       |
| September  | 55.104       |
| October    | 54.248       |
| November   | 38.000       |
| December   | 53.488       |
| Total      | 627.028      |
The data following is the 2015 clinker production demand.

**Table 3. Clinker request data in Indarung III for 2015**

| Period     | Demand (Ton) |
|------------|--------------|
| January    | 56.234       |
| February   | 46.056       |
| March      | 62.744       |
| April      | 49.550       |
| May        | 36.000       |
| June       | 56.000       |
| July       | 58.000       |
| August     | 58.000       |
| September  | 56.000       |
| October    | 58.000       |
| November   | 56.000       |
| December   | 57.200       |
| **Total**  | **649.764**  |

The following data is the 2016 clinker production demand.

**Table 4. Clinker request data in Indarung III for 2016**

| Period     | Demand (Ton) |
|------------|--------------|
| January    | 52.000       |
| February   | 54.000       |
| March      | 51.330       |
| April      | 49.560       |
| May        | 58.000       |
| June       | 56.000       |
| July       | 46.000       |
| August     | 46.000       |
| September  | 56.000       |
| October    | 56.550       |
| November   | 56.000       |
| December   | 58.000       |
| **Total**  | **639.440**  |

The following data is the engine capacity of each Indarung plant.

**Table 5. Machine capacity in each factory**

| Indarung | Capacity (Ton/Day) | Number of Machine (Unit) |
|----------|--------------------|--------------------------|
| II       | 950                | 2                        |
| III      | 950                | 2                        |
| IV       | 2.500              | 2                        |
| V        | 4.000              | 2                        |
4. Result and Discussion
Problem solving is done by scheduling MPS (Master Production Scheduling). Before making an MPS, demand forecasting is made for 2017. Request forecasting is done using the linear regression method. Historical data for three years is divided into four quarters where each quarter consists of three months. The historical table of requests can be seen in the following table.

**Table 6. Historical data demand for three years**

| Quarter   | 2014 (ton) | 2015 (ton) | 2016 (ton) | Total (ton) | Average Capacity of 3 Years (ton) |
|-----------|------------|------------|------------|-------------|-----------------------------------|
| 1 (Jan-Mar) | 144.670    | 165.034    | 157.330    | 467.034     | 155.678                           |
| 2 (Apr-Jun) | 167.312    | 141.550    | 163.560    | 472.422     | 157.474                           |
| 3 (Jul-Sep) | 169.312    | 172.000    | 148.000    | 489.312     | 163.104                           |
| 4 (Oct-Des) | 145.736    | 171.200    | 170.550    | 487.486     | 162.495                           |
| Total (ton) | 627.030    | 649.784    | 639.440    | 1,916.254   | 159.687                           |

After getting the index for each quarter, we must know the forecast value of demand in 2017 using linear regression based on the data in the following table.

**Table 7. Calculation of constant values**

| Year | Yi | Xi | Xi² | Yi.Xi |
|------|----|----|-----|-------|
| 2014 | 627.030 | 1   | 1   | 627.030 |
| 2015 | 649.784 | 2   | 4   | 1,299.568 |
| 2016 | 639.440 | 3   | 9   | 1,918.320 |
| Total (ton) | 1,916.252 | 6   | 14  | 3,844.918 |

Table 7 describes the demand for each year, where Y represents the demand and X represents the period or month to which. Then we get the total multiplication of the coefficient Y and X to get the total demand for a period of 3 years.

**Table 8. Demand forecast results in 2017**

| Quarter   | Demand (ton) | Average Capacity of 3 Months (ton) |
|-----------|--------------|-----------------------------------|
| 1 (Jan-Mar) | 149.630     | 49.877                           |
| 2 (Apr-Jun) | 152.714     | 50.904                           |
| 3 (Jul-Sep) | 157.343     | 52.448                           |
| 4 (Oct-Des) | 157.343     | 52.448                           |
| Total (ton) | 617.030     | 205.677                           |

After calculating per quarter, requests are obtained every 3 months or 1 quarter to estimate the number of requests in 2017.

**Table 9. Demand forecast results each weeks in 2017**

| Bulan | Week 1 | Week 2 | Week 3 | Week 4 |
|-------|--------|--------|--------|--------|
| January | 12.340 | 12.340 | 12.340 | 12.340 |
| February | 12.340 | 12.340 | 12.340 | 12.340 |
| March | 12.340 | 12.340 | 12.340 | 12.340 |
| April | 12.855 | 12.855 | 12.855 | 12.855 |
| May | 12.855 | 12.855 | 12.855 | 12.855 |
| June | 12.855 | 12.855 | 12.855 | 12.855 |
| July | 12.855 | 12.855 | 12.855 | 12.855 |
5. Conclusion
The conclusion obtained after calculating the MPS or master production schedule is, the available capacity can meet existing demand if the factory operates every day with working days assumed to be 29 days per month for a year. This will benefit the company because in addition to meeting demand, production also has a surplus every month. The profit obtained is because the production carried out will be more than needed.

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