Improving Coffee Xyz's Production Planning Using Forecasting and Master Production Schedule

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Abstract

The objective of this study is to improve Coffee Xyz's production planning method by using sales forecasting and Master Production Schedule (MPS). We use Simple Moving Average (SMA) to forecasting. Simple Moving Average is one of the forecasting methods that works by calculating the average over a specific time span backwards without using weighting. This method is used for data that is unstable, no noticeable trend or seasonality.and does not use weighting. By considering cafe XYZ, which is included in the micro, small, and medium-sized enterprise (MSME) that does not employ forecasting or MPS in it's production, we recommend that Cafe Xyz implement production planning with forecasting and a Master Production Schedule (MPS) to help them anticipate stockout, increase production efficiency, and better control costs by estimating material requirements more accurately and avoiding waste in raw material purchases.

Keywords
Forecast, Master Production Scheduling, and Production Planning.

1. Introduction
Interest and consumption of coffee keeps growing every year. This phenomenon encourages many people to start their own Coffee shop, offering more varied coffee products at a more affordable price range. To be able to set business in motion and generate profits, each company must establish the most suitable aggregate planning strategy for their business. Maximum profit can be reached by finding the optimal solution between meeting maximum demand and lowering cost. Most small apparel companies use chase strategy, where the production rates are varied each time period to meet changes in demand. This strategy is deemed most suitable for small apparel businesses since this strategy requires lower capital requirement and the resources needed are flexible and inexpensive to change.
Forecasting and planning play a huge role in determining the production rate to balance the customers' order. Good forecasting and planning will lead to on-time delivery, minimum waste, and minimum production cost. To optimize the chosen strategy, the company needs to have a well planned production as well as raw material stock schedule. Delay in the supply of materials and inappropriate storage of materials can result in delays in the completion of a project or even stopping the project, resulting in complaints and customer dissatisfaction that will decrease the competitiveness of the company (Nurcahyo et al. 2020). Forecasting and planning are critical in establishing the production rate needed to balance the customers' orders (Regina et al. 2021)

1.1 Objectives
The objective of this study is to improve Coffee Xyz's production planning method by using sales forecasting and Master Production Schedule (MPS).

2. Literature Review

2.1 Production Planning

Production planning is a part of production planning and control, involving basic concepts such as what to produce, when to produce, and how much to produce. Product availability is the most crucial aspect of customer service in the manufacturing industry (Coyle et al. 1992). It involves long-term observation of the overall production plan. Therefore, the goal of the production plan is to ensure that the correct quantity and quality of raw materials, equipment, etc. are available during production, and that the capacity utilization rate is always consistent with the forecast demand. Production control hopes to use different types of control technologies to achieve the best performance of the production system, so as to achieve the overall production plan goals. A manufacturing company that carries out the production process is a very important part, so every company must be able to produce well. To carry out production functions properly, a series of activities is needed that will form a production system.

The planning process starts with demand planning to determine the Master Production Schedule (MPS). For the type of mass production that involves only one type of product, production planning does not need to go through the disaggregation stage, and production planning has become MPS. Production planning and control (PPC) addresses logistical issues in manufacturing, such as determining what and how many products to produce and when and obtaining raw materials, spare parts, and resources to produce these products (Muhammad et al. 2017). The function of the production plan are to determine the output based on the sales forecast, decide whether to manufacture or purchase according to cost economics, determine the operating sequence according to product specifications, determine the number of runs and the number of settings based on the target Minimize the total amount of work-in-process inventory, determine each product: the type of material used, the machine to be operated, and tools used, determine the right place and right time when these functions are required, and undertake steps to fulfill the production target established by master schedule and budgets (Nurcahyo et al. 2016).

2.2 Forecasting

Forecasting is a prelude to planning. Before making plans, an estimate must be made of what conditions will exist over some future period. How estimates are made, and with what accuracy, is another matter, but little can be done without some form of estimation (Arnold et al. 2007). Forecasting is a decision-making tool used by many businesses to help in budgeting, planning, and estimating future growth. Therefore, companies should apply forecasting to have a clear vision for the future (Aseel et al. 2018). Forecasting means predicting the future based on past, present data and most commonly by analysis of trends. The more data used for forecasting the more accurate the results. However, there is evidence from the case that the reason lies in environmental uncertainty and volatility and not in internal factors within the control of the company (Rieg 2009). Quantitative forecasting methods rely on mathematical models. There are many different types of quantitative models, including regression models, moving averages, exponential smoothing, ARIMA, and advanced methods like the Bayesian method and simulation. (Zellner et al. 2021). Forecasting by moving average method based on time series is generated by a constant process subject to random error, then the mean is a useful statistic and can be used as a forecast for the next period. Moving averaging methods are suitable for stationary time series data where the series is in equilibrium around a constant value (the underlying mean) with a constant variance over time (Ali et al 2018). Results show that companies adopting a structured forecasting process positively impact operational performances not only through improved accuracy (Kalchschmidt 2008).

2.3 Master Production Planning (MPS)

The Master Production Schedule is one of the most essential tools for controlling product availability (MPS). MPS is defined as a feasible production plan that specifies the quantity and time required to produce individual end items (Sheikh, 2002). The master production schedule (MPS) is a plan for the production of individual end items. It breaks down the production plan to show, for each period, the quantity of each end item to be made. Inputs to the MPS are the production plan, the forecast for individual end items, sales orders, inventories, and existing capacity. According to Gaspersz (2004), basically the master production schedule is a statement about the final product (including replacement parts and spare parts) of a manufacturing industrial company that plans to produce output in terms of quantity and time period (Gaspersz, 2004). Master production scheduling (MPS) is developing plans for identifying which quantities of products should be manufactured during specific periods. MPS, therefore, drives operations in terms of what is assembled, manufactured, and bought (Vieira et al. 2006). Optimization in production scheduling

aims to determine effective scheduling of production based on demand (Nurcahyo et al. 2020). MPS also provides sales with information about what can be promised to customers and when deliveries can be made, making the method a critical link between customer order management and production (Zhao et al. 2001).Because of these characteristics, MPS is the basis for meeting delivery promises while avoiding high inventory levels and resolving trade-offs between sales and manufacturing (Jacobs et al. 2011).

The amount of Master Production Scheduling (MPS) was generated by paying attention to the customer order and the lot size from production activity (Putra et al. 2021). The level of detail for the MPS is higher than for the production plan. Whereas the production plan was based upon families of products (tricycles), the master production schedule is developed for individual end items (each model of tricycle). The planning horizon usually extends from 3 to 18 months but primarily depends on the purchasing and manufacturing lead times. This is discussed in Chapter 3 in the section on master scheduling. The term master scheduling describes the process of developing a master production schedule. The term master production schedule is the end result of this process. Usually, the plans are reviewed and changed weekly or monthly.

3. Methods

We use Simple Moving Average (SMA) to forecasting. Simple Moving Average is one of the forecasting methods that works by calculating the average over a specific time span backwards without using weighting. This method is used for data that is unstable, no noticeable trend or seasonality.and does not use weighting.

Formula that is applied in the SMA method is:

$$SMA = \frac{x_{t-1} + x_{t-2} + \cdots + x_{t-n}}{n}$$

Where X_t = Value for metrix x
n = no. of spans in subset.

In this paper, the number of periods chosen is eight consecutive weeks in order to get more solid forecast results while using limited data. The historical data which was used are from Week 1 of January 2022 until Week 4 of February 2022. By comparing the demand forecast with the production capacity forecast, the Cafe ability in satisfying the upcoming demand can be deduced.

4. Data Collection

According to an interview with the staff of Cafe Xyz, Table 1 shows Es Kopi Pandan's sales and Table 2 shows Es Kopi Pandan's sales.

Table 1. Data of Es Kopi Pandan Sales in January 2022

Time Period	Sales
Week 1	142
Week 2	136
Week 3	140
Week 4	126

Table 2. Data of Es Kopi Pandan Sales in February 2022

Time Period	Sales
Week 1	143
Week 2	132
Week 3	129
Week 4	131

Figure 1 shows Bill of Material from Es Kopi Pandan. This data taken from January 2022 until February 2022.

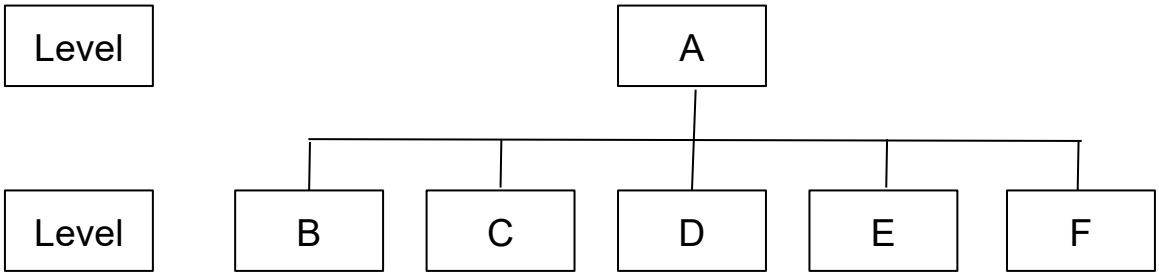

Figure 1. Bill of Material

A : Es Kopi Pandan
B : 50 gr coffee
C : 110 ml milk
D : 20 sugar liquid
E : 30 ml pandan flavour

5. Results and Discussion

5.1 Numerical Results

To increase the production planning strategy in Cafe Xyz, we need to forecast the demand for the following eight weeks. From the sales data, we with Simple Moving Average method to calculate the demand forecast for the next eight weeks. **Table 3** shows the results of weekly Cafe Xyz's Demand Forecast for Es Kopi Pandan from May 2022 until June 2022.

Table 3. Weekly Cafe Xyz's Demand Forecast from May 2022 until June 2022

Week	Demand Forecast (pcs)
9	135
10	136
11	136
12	137

13	135
14	136
15	136
16	136

From the demand forecast, we made the Master Production Schedule Es Kopi Pandan for the next eight weeks. The lead time for the MPS is set to 0 with the lot size 45, opening inventory is 0. Table 4 shows the Master Planning Schedule for Es Kopi Pandan in next eight weeks.

Table 4. Master Production Schedule for Es Kopi Pandan

Lead Time : 0 Weeks		Time Periods(Weeks)							
Lot size : 45		9	10	11	12	13	14	15	16
Sales Forecast		135	136	136	137	135	136	136	136
Projected Available	0	0	44	43	41	41	40	39	38
MPS		135	180	135	135	135	135	135	135
Available to Promise		0	44	43	41	41	40	39	38

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5.2 Graphical Results (11 font)

With the simple moving average calculation method Figure 1 shows the forecast and the actual sales for the first eight weeks. The data for forecast order is generated from the sales last two month.

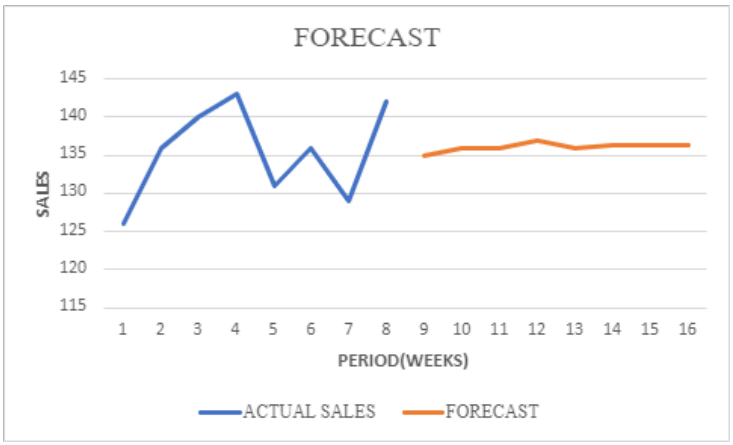

Figure 2. Graph of the actual demand and forecasted demand

5.3 Proposed Improvements

By considering cafe XYZ, which is included in the micro, small, and medium-sized enterprise (MSME) that does not employ forecasting or MPS in it's production, we recommend that Cafe Xyz implement production planning with forecasting and a Master Production Schedule (MPS) as shown in Tables 3 and Table 4 to help them anticipate stockout, increase production efficiency, and better control costs by estimating material requirements more accurately and avoiding waste in raw material purchases.

6. Conclusion

Cafe Xyz is a coffee shop business in Kolaka that is included in micro, small, and medium enterprises (MSME). The café does not use forecasting or MPS in its production. Cafe Xyz operates on a make-to-order basis. But it is felt that there is a problem in the process of purchasing raw materials that relies heavily on customer orders, which are uncertain

every day. To improve the Cafe Xyz's production planning, it is necessary to find a suitable production planning method to implement.

Using the simple moving average method, Cafe Xyz can find forecasts of future demand. Companies can determine the quantity of raw material purchases better because it is based on forecasted demand taking into account existing inventory and net needs. By using forcasting and MPS calculations, this business can anticipate stockout, increase production efficiency, and better control costs by estimating material requirements more accurately and avoiding waste in raw material purchases.

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Biography

Farhan Ahmad Alfian is an industrial engineering student at Universitas Indonesia batch 2020. Born in Kolaka 15 August 2002. He had an experience becoming a part of IKHTIAR IMTI 2021. He especially has an interest in designing and production systems for manufacturing. He is also a person that has a good ability to adapt with a new environment and is highly motivated in studying new things.

Ivandi Yudha Anugrah is an industrial engineering student at the University of Indonesia batch 2019. Born in Kambang 23 September 1999. He has experience being part of SIWA IMTI 2020. He has an interest in human studies based on ergonomics and production systems for manufacturing. He is also someone who has good adaptability to new environment and has high motivation in learning new things.

Athallah Yuritra is also an industrial engineering student at the University of Indonesia batch 2020 that an interest in analyzing and optimizing a system to make better living and more efficient. Born in Tangerang 5 April 2002. Was part of SIWA IMTI 2021 and now being the Vice Head of SIWA IMTI 2022 lead a division consisting of 11 staff to fulfill all the goal in assisting the students of Industrial Engineering passion in sports and arts.

Arief Nurdini is a Ph.D student in Industrial Engineering Department, Universitas Indonesia.