Improving Production Planning Strategy in Micro Business by Using Forecasting and Master Production Scheduling: Soku Bakery Case Study

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Abstract

This study aims to implement the Master Production Schedule (MPS) method for the production process at Soku Bakery. The authors conducted an interview with the owner of Soku Bakery regarding information about current production planning which includes inventory records, Bill of Materials (BOM), customer orders, production plans, and capacity. With the information, the Soku Bakery production process was optimized by making a Master Production Schedule (MPS) from the forecast that has been made. Aside from the data collection, the authors also collect literature from books, journals, and research related to Forecasting and the Master Production Schedule. The result shows that the implementation of the Master Production Schedule (MPS) can help Soku Bakery to adjust fluctuations in demand, minimize waste, prevent shortages, and scheduling errors, and provide more effective cost control and more accurate estimates of material, also requirements, and delivery dates.

Keywords
Forecast, Master Production, Master Scheduling, Production Plan, and Inventory Planning.

1. Introduction
Micro, Small, and Medium Enterprises (MSMEs) are businesses run by individuals, households, and small business entities. The classification of MSMEs is based on the amount of turnover per year, the amount of wealth or assets, and the number of employees employed. MSME is a business group with the most significant number in Indonesia. In 2022, MSMEs were recorded to have contributed 61% of Indonesia's gross domestic product (GDP). Most companies, especially small medium industries face seasonal demand and production problem, which lead to the emergence of lean and peak periods. Such variation in demand and supply is normally beyond the manufacturer's control (Lim et al. 2014).

One of the MSMEs engaged in the food sector is Soku Bakery. Soku Bakery is an MSME located in Jakarta. Soku Bakery can be classified into MSMEs because they have small capital and profits. This bakery processes raw materials into ready-to-eat products with a limited expiration date. The business model run by Soku Bakery is make-to-stock. However, the amount of stock made fluctuates and sometimes increases with the arrival of other orders. Therefore, sales and production at the Soku Bakery are not good and not optimal.

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 and Favaretto 2006). Meanwhile, forecasting is thinking about a quantity, for example, the demand for one or more products in the future period (Ishak 2010).

Through forecasting and MPS, Soku Bakery can improve its production system as forecasting and planning are critical in establishing the production rate needed to balance the customers' orders (Rahmat et al. 2021). Soku Bakery can also estimate the amount of production in a period to determine the amount of raw material purchases.

1.1 Objectives
The objective of this research is to optimize Soku Bakery production planning by implementing forecasting method to make a standardized Master Production Schedule. Considering the minimal amount of Master Production Schedule (MPS) model implementation in Soku Bakery planning, the possibility of their current method failing, or succeeding have never been confirmed. Through this research, the authors hope to discover a better production planning method to be implemented.

2. Literature Review
A vast literature exists that Small and Medium-Sized Enterprises (SMEs) perform worse than large ones due to the lack of human and financial resources. It keeps SMEs from adopting new technological solutions and innovative managerial practices necessary to improve their performance (Grando et al. 2006). Under the information environment, SMEs engaged in manufacturing continuously encounter daily internal and external disturbances to their operations, the smooth running of SMEs is a significant challenge (Islam et al. 2008). The problem is more serious in SMEs as compared to large industries due to the typical lack of access of such firms to adequate financing for the expansion of facilities. Thus, SMEs often rent readily available industrial space for storage and purchase off-the-shelf equipment readily available in the market. Therefore, proper production planning is critical for SMEs to survive in the market (Lim et al. 2014).

Demand forecasting includes the process of estimating customer demand within a period. It utilizes historical data or trends to project future revenue and production planning, affecting business strategies (Raghunathan 1999). Results show that companies adopting a structured forecasting process positively impact operational performances not only through improved accuracy (Kalchschmidt 2008). Demand forecasting aims to reduce loss, increase customer satisfaction and retention, form better management, and optimize the supply chain process. Forecasting means predicting the future based on past and present data and, most commonly, analyzing trends. The more data used for forecasting the more accurate the results (Rieg 2009).

Forecasting methods are divided into two types, quantitative and qualitative, determined by the pattern of demand for specific products. Qualitative forecasting methods used experts, intuition, surveys, or particular judgment to produce estimation, so it is also known as a subjective forecasting method. If historical data is available from the organization or company, the forecast results may be irrelevant. 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).

Moving Average Method forecasting is forecasting based on time series 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. The series is in equilibrium around a constant value (the underlying mean) with a constant variance over time (Gudagunti and Ali 2018). In this method, subsets are generated, and the mean of the subsets has plotted them to find out the movement of the line segment generated by connecting points plotted at averages. However, the subset must have minimum values to find the mean. As data from a new time period is added, data from an earlier time period is dropped from the average calculation.

Product availability is the most crucial aspect of customer service in the manufacturing industry (Coyle et al. 1992). 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). Whereas the production plan is concerned with product families, the MPS is concerned with end items. It divides the production schedule into the needs for individual end items in each family by date and quantity. Because the production plan restricts MPS, the total of the items in the MPS should not differ from the total shown on the production plan. Optimization in production scheduling aims to determine effective scheduling of production based on demand (Rahmat et al. 2020). MPS helps determine the amount of product needed per period to meet anticipated customer demand using data from the beginning inventory and the demand forecast for a particular end item.

The MPS data is then used to measure the raw material requirements to meet the planned production schedule. As a result, MPS drives operations based on what is assembled, manufactured, and purchased (Vieira and Favaretto 2006). 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 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. Through MPS, Production planning and control (PPC) can be accomplished. 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 (Rahmat 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 (Rahmat et al. 2016).

3. Methods

Simple Moving Average (SMA) is one of the technical indicators which is widely used to predict future data in time series analysis. It is appropriate when there is no noticeable trend or seasonality. In this paper, Simple Moving Average (SMA) is used to find out mean of past sales and use it as the forecast value of Soku Bakery's projected demand. Since the object of this paper is a micro company which sells breads, their demand and production pattern is not considered as seasonal. Moving averages are also useful to filter out random fluctuations. This has some common sense since periods of high demand are often followed by periods of low demand.

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.

4. Data Collection

According to an interview with the owner of Soku Bakery, table 1 shows the quantity of bread sold during that week. The data is taken between November 2021 and April 2022, with an average of 566.08 pieces of bread sold per week. Table 2 shows the bread sold each day according to the week. Based on table 2, Thursday has the highest average of bread sold while Friday has the minor average. It happens because there were several days off on Friday in several weeks. We can use forecasting to project sales for the next six weeks.

Table 1. Weekly Soku Bakery's Order from February 2022 until April 2022

Week	Actual Order (pcs)
1	852
2	587
3	402
4	665
5	473
6	572
7	764
8	494
9	531
10	583
11	346
12	524

Table 2. Weekly Soku Bakery's Order from February 2022 until April 2022

Week	Actual Order	M	T	W	T	F	S	S
1	852	78	74	272	94	210	54	70
2	587	84	98	60	123	105	45	72
3	402	34	66	13	97	60	60	72
4	665	31	100	133	116	0	76	209
5	473	67	66	68	134	0	76	62
6	572	91	92	94	43	0	180	72
7	764	60	248	70	176	90	62	58
8	494	47	98	86	122	0	83	58
9	531	18	75	87	110	54	110	77
10	583	76	94	88	65	37	85	138
11	346	64	70	60	77	36	0	39
12	524	85	21	66	49	84	105	114
Average	566,08	61,25	91,83	91,42	100,50	56,33	78,00	86,75

5. Results and Discussion

5.1 Numerical Results

In order to increase the production planning strategy in Soku Bakery, we need to forecast the demand for the following six weeks. The selection of the number of periods of 6 weeks is adjusted to the needs of Soku Bakery, a micro business. The appropriate period for a micro business is between a short period to a medium period.

Using Simple Moving Average Method, here is the forecasted demand:

Table 3. Weekly Soku Bakery's Demand Forecast from May 2022 until June 2022

Week	Demand Forecast (pcs)
13	541
14	504
15	505
16	501
17	487
18	510

The result shows that the average projected sales for the next six weeks are 508 orders. If the owner of Soku Bakery continues to follow their current routines, they need to adjust their daily spending on supply to avoid overstock inventory that may cause extra spending.

5.2 Graphical Results

Figure 1 shows the demand forecast and the actual demand for the first twelve weeks. With this forecasted data, we can proceed to make a Master Production Schedule for the Soku Bakery owner to plan their inventory for the next six weeks.
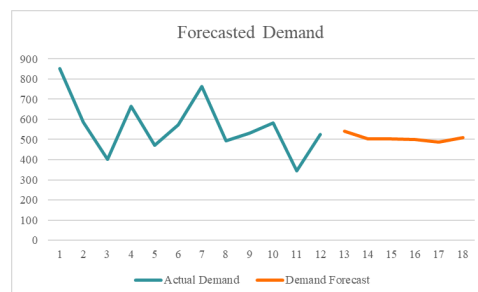

Figure 1. Graph of the actual demand and forecasted demand

5.3 Proposed Improvements

With table 3 and figure 1 shows the forecasted demand for the next six weeks, Master Production Schedule (MPS) can be made to plan Soku Bakery inventory planning for the next six weeks. The lead time for the MPS is set to 0 week as Soku Bakery usually prepare their bread daily with the lot size 170 per week. The opening inventory is 0 with the aim of ending inventory as small as possible to avoid expired products sold. This cycle will continue within six weeks that will create Soku Bakery production plan for the next six weeks.

Table 4. Forecasted Master Production Schedule of Soku Bakery Inventory Planning

Lead Time: 0 Weeks		Time Periods					
Lot Size: 170		13	14	15	16	17	18
Sales Forecast		541	504	505	501	487	510
Projected Available	0	139	145	150	159	12	12
MPS		680	510	510	510	340	510
Available to Promise		139	145	150	159	12	12

6. Conclusion

Soku Bakery is a micro, small, and medium-sized enterprise (MSME) in the food industry based in Jakarta. Soku Bakery's business model is make-to-stock. However, the stock fluctuates based on customer orders, and the sales and production were not optimal. To optimize, Soku Bakery needs to discover a better production planning method to be implemented.

With simple moving average methods, Soku Bakery can find the upcoming forecasted demand. The company can better determine the production quantity because it is based on forecasted demand while taking on-hand inventory and net requirements into account. Using empirical calculations, the company can avoid situations where the quantity of materials exceeds or falls short of the required amount. Then, implementation of Master Production Schedule (MPS) is performed as the proposed improvement method, according to the results, the average projected sales for the next six weeks 508 orders. If the owner of Soku Bakery sticks to their current routines, they will need to adjust their daily supply spending to avoid overstock inventory, which may result in extra spending. The use of this method also resulted in Soku Bakery being able to meet the customer demand schedule on time.

With the result in Soku Bakery, It is essential for micro-businesses to implement this model because the implementation of the Master Production Schedule is still rarely used. Overall, the problem of purchasing raw materials and the amount of production by micro-businesses, which sometimes does not match the number of requests on a specific day, can impact the costs incurred, resulting in waste. By implementing forecasting methods and master production schedules, these small companies can forecast the number of requests and prepare better production plans to reduce waste. The forecast method and the Master Production Schedule can be the beginning of applying other methods in the production process that can help small businesses develop in the future.

This study was completed with various constraints. These constraints are in the form of a post-pandemic that will be faced soon, and the types of SMEs circulating are very diverse. This indicates that in the future, SMEs will experience changes in demand with world conditions starting to enter a post-pandemic. In addition, Soku Bakery is one of the SMEs included in the type of food. Meanwhile, SMEs in circulation also consist of beverages, products, and other types. Thus, the solution offered is still unknown whether it will be effective against other types of SMEs. Future studies are needed to study whether the solutions offered can be implemented in other types of SMEs.

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Biography

Dendy Rio Casillas Pratama is an undergraduate industrial engineering student at University of *Indonesia* and currently active in student organization. His research interests include quality systems and system modelling. He was actively involved in Ikatan Mahasiswa Teknik Industri as Head of Religious Affairs in 2021. Currently, he is The Chairman of Ikatan Mahasiswa Teknik Industri.

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Arief Nurdini
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