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IMPROVING MATERIAL SHORTAGE FOR SMALL-MEDIUM ENTERPRISES (SME) IN PEST CONTROL INDUSTRY

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Abstract: *Micro, Small, and Medium Enterprises (SME) are the main pillars of the Indonesian economy because they have a strong foundation in driving the wheels of the national economy. Inventory is an essential factor in SME production costs to boost competitive advantage. Conventionally, Local SMEs in the pest control industry do not yet have a method or system of inventory control for pest control raw materials. This study tries to conduct in-depth research of local SMEs in the pest control industry to minimize the shortage of raw materials. An observation of this study found out that material shortage in local SME could happen every month that caused stop supply to customers. The objective of this paper proposes an appropriate and efficient stock of pest control material to improve the shortage problem. For achieving the research objective, the approach used a case study on Nuvaq material inventory in an SME in Jakarta, Indonesia.. The forecasting technique with minimal error is the Linear Regression method giving results with the smallest forecast errors. It can be seen from the smallest MAD, MAPE, SEE, and MSE. The economic order quantity is 100 Liter Nuvaq Material, reorder points can be made when the supply is 36 Liters, and safety stock for Nuvaq raw materials is 16 liters.*

Keywords: SME, pest control, shortage material, inventory

INTRODUCTION

Micro, Small, and Medium Enterprises (SMEs) are the main pillars of the Indonesian economy because they have a strong foundation in driving the wheels of the national economy. SME reduces inequality between income groups and between business actors and reduces poverty and unemployment (Kore & Septarini, 2018). SMEs contributed to the Gross Domestic Product (GDP) in the 2008-2014 period increasing from 55.67 % to 61.41 %, then in the 2008-2013 time frame, the number of employment by SMEs increased by 20,119,804 people or 17.62% (www.depkop.go.id).

National SME growth always shows an increase. During the period 2008-2014 the number of MSMEs in Indonesia increased by 7,853,160 units or 15.26% (www.depkop.go.id). Although the growth of SMEs has increased nationally, local industries in Indonesia are still weak in managing traditional business operations, making them less competitive (Hasbullah, 2021). The national industry, especially SME, still has less than optimal competitiveness in technology, work operations, productivity, and efficiency. It is the main reason Indonesia supports SMEs developing and growing as the backbone of the national economy (Hasbullah, 2021).

Inventory is an essential factor in manufacturing production costs (Hasbullah & Santoso, 2020). A production line in a company, both manufacturing, and service, can convert raw materials to finished goods. The manufacturing industry processes raw materials into a finished good. The service industry processes services according to customer needs. Control of raw material is essential in the production process so that raw materials are used in the right amount and at the right time (Agung & Hasbullah, 2019). Lack of

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inventory will result in the cessation of production process activities. Likewise, excess inventory will affect the cost of storing and production operations.

This study has attempted to study ten SME industries in the pest control service industry in Indonesia. Products offered include cleaning services, pest control, washroom hygiene, glass cleaning for outdoor buildings, and other maintenance services. A more in-depth research study was carried out at a company in Jakarta through a case study that focused on the main problem in this industry, namely material shortage. In the ten SME of the pest control industry observed, some issues need to be underlined about how SME supply materials to meet customer demands. Almost all of them often experience material shortages, which causes service to customers to stop. This problem can cause local industries to be less competitive than large industries or foreign companies in the same industrial sector.

Local SMEs in the pest control industry do not yet have a method or system of inventory control for pest control raw materials. In other words, planning and controlling pest control raw material supplies is still based on experience and predictions from the supervisor level. It causes a shortage of raw materials for pest control, resulting in frequent interruption of work processes. As a result, the company experiences a loss or, in other words, a decrease in income. This study tries to conduct in-depth research of local SMEs in the pest control industry to minimize the shortage of raw materials. An observation of this study found out that material shortage in local SME could happen every month that caused stop supply to customers.

Inventory

Inventories are material deposits that can be in raw materials, work in progress, and finished goods. From the point of view of a company, inventory is the capital investment needed to store material under certain conditions (Indroprasto, Suryani Erma, 2012). Inventory is many materials, parts provided, and materials in the company for the production process and finished goods/products provided to meet demands from consumers or subscriptions at any time (Assauri, 2008). In other words, inventory represents some resources in raw materials or finished goods provided by the company to meet consumer demand (Sofyan, 2013). From some of the above meanings, inventory is an idle resource either in raw materials that are still waiting for further processing or finished goods used to meet customer demand or to cope with fluctuations in the market.

The existence of inventory will cause certain risks that the company must bear due to the stock (Rossit et al., 2019). For example, stock can be damaged before it is used, expired, high storage cost, or the quality may deteriorate. In addition, the company must also bear the costs that arise as a result of this inventory. For some companies, a safe inventory policy is to have a large amount of stock. Still, this results in high costs arising from the availability of supplies for storage and purchase of the materials or goods concerned. If the inventory is under stock, there is a risk of a shortage of materials or goods (out of stock). It will disrupt the smooth running of the production process. Besides that, the purchase costs and inventory costs will also increase. Therefore the company must have a sound inventory control system. An inventory control system can be defined as a series of control policies to determine the level of inventory that must be maintained when to place an order to increase inventory and how many orders to place.

Consumer demand in the pest control industry is dynamic and unpredictable. Instability like long lead times, rapid product life cycle, inaccurate forecasts, significant product variations, volatile supply, impact poor production planning, and inability to comply with current environmental demand conditions (Ptak & Smith, 2011). The situation has a significant impact on the complexity of the supply chain in various corporate goods and services. A survey from the research prominent Aberdeen Group, in which 48% of the companies had signs of excessive pressure on the company due to the supply chain or the increasingly complex supply chain. The fluctuations and the risk of mismatch predictions with actual demand impact changes in production planning made so far (Shao et al., 2021). Research related to managing stock in the pest control industry is few carried out. Research in production planning, inventory, and optimizing stock and capacity, generally using dynamic programming models (Attarian, Javanmard, Mardani, & Soltan, 2009).

Economic Order Quantity

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Order Quantity (EOQ) is a simple method of providing materials economically (Godichaud & Amodeo, 2019). This method aims to determine an economic ordering size that can minimize unnecessary costs in inventory. EOQ answers two critical questions, when to order and how much to order. If an item is requested from a supplier, regardless of the number of items ordered, the cost of ordering (telephone, delivery, administration, etc.) is often the same. It means that the cost of the order does not depend on the number of orders but on the number of times the number of orders. If a product is produced, the company must prepare production resources and other supporting resources (Zhong et al., 2015). There are fixed costs, and there are costs that change if the number of production changes. In general, the total cost is directly proportional to the quantity produced.

If the order quantity exceeds the economic order quantity, it will result in higher costs . But if the number of orders for product units is less than the number of economic orders, the ordering costs will be higher. It causes the company to have to order products many times with the ordering fee charged repeatedly. The EOQ method determines the most economical number of orders (Q) to minimize inventory costs. But it should be underlined that in determining to spend, the value of Q that needs to be considered is the relevant costs only. The purchase cost component can be neglected because these costs will arise without depending on the frequency of orders. The EOQ method aims to minimize inventory costs with the ordering and storage cost components only.

For the P method, the ordering time is determined in advance, for example, weekly, monthly and yearly, but for the Q model that is determined beforehand is the number of Q. Compared to the P model, the Q model is relatively better because with the P method there is a possibility that the inventory has run out before the reorder period has not yet reached. As a result, the required safety stock is getting bigger, and the possibility of a greater stock out, with fluctuating demand if the company procures a large inventory, it is not certain that the request will be as big as the supply provided so that the storage cost will be even greater. For the Q method, the company places an order when the inventory is at the reorder point so that the inventory cost and the possibility of stock out are smaller. To find the optimal Q using the EOQ method is as follows:

$$Q = \sqrt{\frac{2DA}{h}}$$

Information :
Q = Optimal order quantity
D = Number of orders in one year
A = Cost in one order
h = Storage cost in one year

Safety Stock

Safety stock is a safety stock to determine how much inventory is needed during the grace period in meeting the amount of demand (Godichaud & Amodeo, 2019). The purpose of the safety stock is to determine how much stock is required during the grace period to meet the size of the request. There are three components considered in determining safety stock: variations in demand, lead-time, and service level. In terms of variations in the market, we rarely find cases where the market is stable, let alone the same every month. There is always a variation in order. Logically, the higher the variation in demand from time to time, the greater the chance for a stock out (shortage of supply when there is demand). Therefore, this demand variation factor must also be directly proportional to the safety stock we must prepare.

The lead-time component is an essential factor in determining safety stock. There are various kinds of lead times ranging from production lead times, transportation lead times, and other lead times depending on the terminology of each company. It is clear that from the time a product is ordered until it is delivered to the orderer, its time also varies. As with variations in demand, the greater the lead time, the greater the safety stock we need. Meanwhile, the service level. Another critical factor in safety stock is the service level. Each

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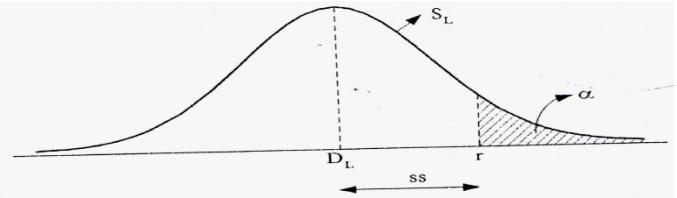
company needs to determine how many service levels are provided to its customers. In simple terms, if there are 100 requests, they cannot be fulfilled, then the service level is 95%. The ideal is 100%, but that means the company must provide a vast safety stock. Because safety stock is an inventory, the money invested must also be considered.

Any fluctuation in needs must receive serious attention to know how much it has happened and how many times in a year, and at what time it happened. All of this will be used as a basis for determining the size of the safety stock. When the demand during the order arrival period (lead time) cannot be known with certainty in advance, then the deviation of when supplies are needed and when the supplies arrive must be known. One of the popular models in determining stock is the standard distribution approach. It follows the fluctuating characteristics of the pest control industrial material conditions as shown in Figure 1 below.

Figure.1 Normal Distribution Reserve Inventory



Source: Sistem Inventori, Bahagia, 2003.

In Figure 1, it is explained that DL is the expected demand during the run time, SS is the amount of safety stock, the amount of which is from DL to r. Meanwhile, r itself is the point of reordering. If the amount of inventory is less than the point of order, it is the amount of stock out or α. In determining α, it can be found using the t distribution table. In addition, the lead time factor is also considered in determining the reserve inventory. So that to find safety stock is:

$$\text{Reserve Inventory} = \text{Safety Factor } (\alpha) \times \sigma$$

Reorder Point (ROP)

If EOQ is a control for optimal inventory ordering, then ROP (Reorder Point) is an inventory control to start ordering procurement (Godichaud & Amodeo, 2019). ROP occurs when the amount of inventory in stock decreases, so we have to determine the minimum level of inventory that must be considered so that there is no inventory shortage. The expected amount is calculated during the grace period, can also be added to the safety stock, which usually refers to the probability or possibility of a shortage of stock during the grace period. ROP is usually referred to as the limit amount of reordering, including the demand desired or needed during the grace period, for example, an additional stock. Apart from the grace period, other factors determine the ROP, namely safety stock. So to calculate the reorder point is:

$$r = (D \times L) + \text{Safety Stock}$$

r = Re-order point
D = Request
L = Lead time

Forecasting

Forecasting is an objective calculation and using past data to determine something in the future while forecasting subjectively and or not from past data predicts something in the future (Gaspersz, 2005). Activities in forecasting supports decision-making, reducing dependence on things that are uncertain

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(intuitive). Forecasting has the nature of interdependence between divisions or sections. Errors in forecasting projections will affect the budget forecast, operating expenses, cash flow, inventory, and other essential aspects. There are three types of forecasting (Heizer and Render, 2005): the time series model, the causal model, and the judgmental model. Time Series is a quantitative forecasting method using time as the basis for forecasting. Causal Model. Forecasting methods use a cause-and-effect relationship as an assumption, that is, what happened in the past will repeat itself today. Judgmental includes including quantitative or subjective factors into the forecasting method. Especially useful when the expected subjective factors become crucial when accurate quantitative data have been obtained.

A forecasting model will provide different forecasting values and different degrees of forecast error (Lindawati, 2003). One of the arts of forecasting is choosing the best forecasting model that can identify and respond to historical activity patterns from data. In general, forecasting models can be grouped into two main groups, namely qualitative and quantitative methods. The qualitative method consists of the Delphi Method, the Comparative Technology Method, and the Curve Fitting Subjective Method. Meanwhile, the Quantitative Method consists of Time Series, Last Period Demand, Simple Average, Moving Average, Single and Double Exp Smoothing, Multiplicative Winter / Decomposition, Casual (Structural), and Multivariable Regression (Katarina, 2015).

In forecasting, there are several indicators for measuring forecasting accuracy. Still, the most indicators used frequently are (Hartini, 2011); MAD (Mean Absolute Demand), MAPE (Mean Absolute Percentage Error), MSE (Mean Absolute Error). Forecasting accuracy will be higher if the MAD, MAPE, and MSE values are getting smaller. According to Hartini (2006), the meaning of MAD, MAPE, and MSE is MAD, which is the average absolute error during a specific period regardless of whether the forecasting results are greater or smaller than the reality. MAPE is the percentage error in forecasting the actual demand during a certain period, which will provide information about the percentage of too high or too low errors. MSE is the sum of the squares of all forecasting errors in each period and dividing it by the number of forecast periods

RESEARCH METHOD

This study proposes an appropriate and efficient stock of pest control material to improve the shortage problem. For achieving the research objective, the approach used a case study on Nuvaq material inventory in an SME in Jakarta, Indonesia. A case study involves an up-close, in-depth, and detailed examination of a particular case or case within a real-world context. It focused on an individual Nuvaq material. A case study in this industry covers a specific method or technique to provide appropriate and efficient stock to ensure customer demands. The choice of research subject in Nuvaq material shortage relied on observation to ten SMEs in the pest control industry. After identifying the problem of Nuvaq material shortage, this study established the objective from the inventory level of materials for ensuring shortage material problem prevented.

Using forecasting techniques of Linear Regression, Moving Average (MA) with two, three, and five months, this study identifies the ideal technique by choosing the least error as an indicator of forecasting accuracy. Forecasting techniques were chosen (Regression and Moving Average) based on observation, interview, stock characteristics, and focus group discussion (FGD) from academics, company staff, practitioners, and factual conditions. FGD consists of five members from the company internal and external. This study answers three questions research;

1. What forecasting technique with minimal error
2. What the optimal number of orders in EoQ
3. What reorder point (RoP) position and safety stock Nuvaq

RESULT AND DISCUSSION

The analysis in this study is based on data pattern, comparison, order timing, deviation, MAFE, MAD, MSE, and SEE so that the best value of inventory value is obtained. However, they are similar indicators, these indicators representing error level through calculation deviation every forecasting by referring to actual

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data. The severe concern about Nuvaq material shortage occurred in April 2018 – March 2019, as shown in Table 1. Below. Most of the period showed the biggest problem in stock is a material shortage.

Tabel 1. Nuvaq Material Shortage April 2018 -Maret 2019

Period	Demands (liter)	Actual used (liter)	Balance	Remarks
April	48	47	1	Overstock
Mei	50	48	2	Overstock
Juni	58	60	-2	Shortage
Juli	50	50	0	Over stock
Agustus	55	53	2	Over stock
Sept	59	62	-3	Shortage
Okt	48	54	-6	Shortage
Nov	53	49	4	Shortage
Des	50	65	-15	Shortage
Jan	65	55	10	Over stock
Feb	60	63	-3	Shortage
Mar	65	65	0	Shortage
Apr	69	72	-3	Shortage
Mei	72	72	0	Shortage
Juni	68	74	-6	Shortage
Juli	74	75	-1	Shortage
Agust	75	78	-3	Shortage
Sept	65	65	0	Balance
Okt	76	71	5	Over stock
Nov	79	80	-1	Shortage
Des	80	82	-2	Shortage
Jan	97	96	1	Shortage
Feb	100	103	-3	Shortage
Mar	92	90	2	Shortage

Source: PPIC & Warehouse GTP, 2018

From historical data during the period April 2018 - March 2019, there is a difference between requests and actual use, mainly in every period. Based on this description described above, the objective in this study is how to improve the shortage of material needs of Nuvaq, how to determine to reorder points and safety stock that can overcome deficiencies. This section will provide;
1. Determining the optimal number of orders / ordering values
2. Determining to reorder points and safety stock Nuvaq at PT. GTP.
3. Determining the inventory planning method with the lowest cost

From Table 1. above, by use forecasting techniques Linear Regression, Moving Average (MA) with two, three, and five months, this study identifies the forecasting technique to provide forecasting accuracy. Table 2 below showed the forecasting result from Linear Regression, Moving Average (MA) with two, three, and five months. To choose a forecasting technique with minimal errors and accuracy, therefore requiring forecasting with minimal error.

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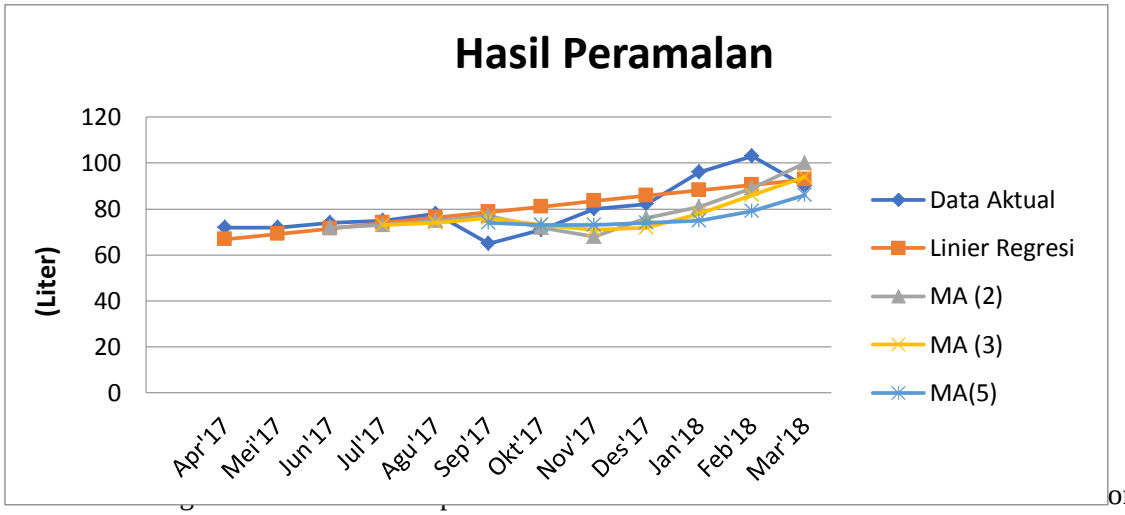
Tabel 2. Forecasting Result

Periode (x)	Bulan	Data Aktual	Linier Regresi	MA (2)	MA (3)	MA(5)
1	Apr'17	72	67			
2	Mei'17	72	69			
3	Jun'17	74	72	72		
4	Jul'17	75	74	73	73	
5	Agu'17	78	76	75	74	
6	Sep'17	65	79	77	76	74
7	Okt'17	71	81	72	73	73
8	Nov'17	80	83	68	71	73
9	Des'17	82	86	76	72	74
10	Jan'18	96	88	81	78	75
11	Feb'18	103	91	89	86	79
12	Mar'18	90	93	100	94	86

Visually, Figure 2 showed a comparison of actual data and forecasting results. It is easier to identify which one is a forecasting technique that the nearest accuracy comparing to actual demand.

Figure 2. Graph of Visualisation Forecasting Result



om the forecast results image. The Moving Average way of forecasting results in the September 2018 period exceeds the actual data. October 2018 is almost at the same point. Although this graph can show which one is closer to actual data, these forecasting techniques require verification to identify the minor error from all forecasting techniques. Table 3. Showed the calculation result MAD, MSE,

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MAPE dan SEE to determine which one is the smallest value representing the most minima error. Regression Liniar is the forecasting technique with all MAD MAD, MSE, MAPE and SEE is the most accurate with minimal error.

Table 3. Comparison MAD,MSE, MAPE, and SEE

Metode	Moving Average			Linier Regression Liniar
	2 Bulan	3 Bulan	5 Bulan	
MAD	8	9	11	5,61
MSE	85	106	177	48,67
MAPE	9,10%	10,01%	12,16 %	7 %
SEE	10,30	11,67	15,75	7,60

The EOQ method is used to determine the optimal amount for economic ordering, when to reorder, and the amount of safety stock that must exist. Calculation of optimal Q, ROP, and safety stock are as follows:

1) EOQ
Q is optimal
EOQ = √ (2.D.S) / H
EOQ = √2,958,5000 / 950
EOQ = √9,580,000 / 950
EOQ = √10084,2
EOQ = 100.42 (100 Liter)

2) Safety Stock
SS = Z x σ
SS = 1.95 x 8 = 16 Units

3) Re- Order Point (ROP)
ROP = L + SS
ROP = 79.83 x 0.25 + 16 = 36 Units

CONCLUSION

The forecasting technique with minimal error is the Linear Regression method giving results with the smallest forecast errors. It can be seen from the smallest MAD, MAPE, SEE, and MSE. The economic order quantity is 100 Liter Nuvaq Material, reorder points can be made when the supply is 36 Liters, and safety stock for Nuvaq raw materials is 16 liters. This finding is based on theoretical perspectives; the organization shall improve current inventory management by applying

affordable information system technology, skill-up employees, and improving visual control management, especially in the inventory control field.

This research just focused on one item of inventory stock of Nuva material by a case study. Some techniques can be applied o other material, and some cases can not be. Some materials have high fluctuation in demand, lead time, availability and constrained by regulation. This concern is a challenge in the following research. Future research requires deeper discussion and broader planning control of the pest control industry to complete a loophole of this study, which can be done better for the smooth running of the production process to ensure customer demands can be met.

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