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Determining Inventory Management Policy for Perishable Materials in Roemah Keboen Restaurant

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Abstract

Roemah Keboen is a company engaged in restaurant industry that faces an inventory management of wasted materials because the materials have shelf life or expired time and can perish on a fixed time. This study was conducted to find appropriate policy to improve Roemah Keboen inventory management and solve the problem that Roemah Keboen faces. The step to improve inventory management of Roemah Keboen starts from describing the business process of Roemah Keboen. By describing each process, the root causes of the problem can identified and analyzed. The root cause occurs in Roemah Keboen is the executive chef conducted the responsibility of determining the amount of materials ordered and timely scheduling of orders in a subjective manner. It makes the wasted materials number is on high level. The proposed solutions are based on periodic review policy and continuous review policy. The best policy selected after calculating the total cost of each policy and comparing the two policies as well as considering their outdated and lost sales cost. Overall, the continuous review policy gives a lower cost after the policy is compared with the periodic review policy and current system.

Inventory Management; Root Cause Analysis; Roemah Keboen; Periodic Review Policy; Continuous Review Policy;Waste Materials; Expired Time

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1. Introduction

Inventory is one of the aspects that can be calculated in every business (Chopra and Meindl, 2010). Inventory is both a financial asset and an operational risk to any business. It is a cornerstone of customer service and a complexity in production efficiencies that directly impacts the cash flow, profit and loss accounts, and overall balance sheet. The short-lived materials make the company should manage their inventory to meet the best performance in fulfilling demand from customers. Error estimation would cause a company make a loss with an overstock that is not used for a business activity or low in stock also can make company's loss because the company cannot fulfill a customer demand.

The problem which is closely related to finding ordering policies for perishable goods is by finding suitable issuing policies. The solution to solve the problem that occurs in Roemah Keboen restaurant determines an optimal inventory management policy to decrease the number of waste materials and the total cost that is spent. The policy that is developed for solving the problem is based on the periodic review policy and continuous review policy.

2. Research Methodology

There are some systematic steps used by the author in doing the research. It starts from problem identification, literature review, research method, data collection, data processing and analysis, and conclusion and recommendation. The first step that the author takes is to do the initial research by identifying the general problem in the company that can be used as the topic of the research. After knowing the general problem in Roemah Keboen, the specific problems were then identified during the initial research. The problems identification was based on the existing information. The problems that occurred at Roemah Keboen are there are many materials that wasted. Theoretical foundations were used to analyze the data, evaluate the problem, and give the solutions and recommendations to the company to solve its problems. The materials of the literature review of this research were collected from some media, such as books, websites, and journals. The theories that were used in this research are Inventory Management, Business Process, and Supply Chain Management. The data collected in this research are based on primary data and secondary data.

The data were processed to describe the business process in Roemah Keboen and the gap performance in Roemah Keboen in order to find the root causes of problems. After that, all of those data were used to propose the solutions. The solutions were based on the theoretical foundations and were made for solving the problems that occurred in Roemah Keboen. The solutions were also made to improve the inventory management in Roemah Keboen. The conclusion is to answer the objectives of the research. After that, there are several recommendations that could be implemented to improve the performance of inventory management of Roemah Keboen.

3. Data gathering and Analysis

3.1 Business Process

The first process in a business process is planning. The planning process includes menu and inventory planning. Menu planning is the process where the executive chef estimates demand from the customers. After that executive chef will plan the amount of inventory that he must order to suppliers. Starting with the gathering of inventory data from the kitchen division, the kitchen division will update the last amount of their materials data daily to its executive chef. The executive chef will then predict how much they need wet materials for next day and how much and what materials will be listed by the executive chef.

After the executive chef has listed the needs of wet materials, the list will be delivered to the accounting division to determine how much the needs will cost besides setting the price limits. Setting the price limits helps the purchasing division to benchmark its buying materials. The purchasing division must buy the materials from the suppliers below the limit price. The materials are divided into two categories: wet and dry. Wet materials are the materials that have short expired time. Examples of wet materials are ribs, tenderloin, oxtail, chicken, sirloin, salmon, vegetable, etc. Dry materials are the materials that have long expired time, for example ketchup, sugar, salt, pepper, etc. For dry materials, the order planning is based on stock checking that is done by the warehouse division. If the number of dry material stock in the warehouse is below the required minimum number of stock set by the warehouse division, the warehouse division will deliver the list of what stock they need to buy to the accounting division. The accounting division will then determine the cost and the price limit before they are delivered to the purchasing division whose responsibility is to buy the materials needed from the suppliers.

For the storage process, it is divided into two activities. For wet materials, suppliers will send wet materials to the kitchen division which will then check the quality of the materials. If the materials do not meet their criteria, the materials will then be sent back to the suppliers. The suppliers must then send back the new materials that meet the requirements set by Roemah Keboen. Roemah Keboen will receive any previously placed orders before it opens in the morning. For dry materials, the materials will be sent by suppliers, and they will be received by the warehouse division. The materials will be stored in the warehouse and some of the materials will be distributed to the kitchen division.

Kitchen cooking activities always start from the preparation. These activities are done every day before and on the operational time. These purposes of the activities are to smooth and prepare the next activity process. Cooking is divided into two categories: make-to-stock (MTS) and made-to-order(MTO). These activities are done in every sub-unit in the kitchen division. Make-to-stock aims to simplify and shorten the time required to make the basic materials for make-to-order. Therefore, when make-to-order is required, the kitchen personnel only reheat the materials.

3.2 Root Cuase Analysis

Based on the business process, the root cause of problem can be identified and analyzed. Roemah Keboen has no system to make sure that there is no wasted material. This restaurant has not set the quantity of ordered materials and when to order materials. Ordering is only based on the last inventory data made by the kitchen division. When the executive chef feels that he/she needs more wet materials to use in cooking the next day, then ordering will be made. If there is a mismatch between the expected sold menu and the food with the actual sales, it will make Roemah Keboen a loss. The reason is that if Roemah Keboen expects the sold menu above the actual sales, this restaurant has more materials in its kitchen division. If the materials pass their expired time, the materials will be wasted. In other words, if the expected sold menu is below actual sales, the restaurant has lost its sales.

3.3 Solution

In the existing system of Roemah Keboen, ordering materials is based on the customer demand predictions of the following day. To solve this problem, three possible alternative replenishment policies are proposed, namely FIFO (first in first out) policy, periodic review system, and continuous review system.

Table 1. Proposed alternative solutions

System	Time to order	Quantity ordered	Description
Existing replenishment system	Nearly expired time materials	Order up to cover 4 days predictions	Inventory check is done every closing time, and order is made if the executive chef feels that more materials for tomorrow sales are needed.
Periodic review policy	Depending on the review period	Qp=S-IP	The review occurs at the end of the day (RP). Remove the outdated materials, and order (Qp) up to S
Continuous review policy	If the inventory position reaches or falls below the reorder point during the check	Q	Inventory is checked every time at the end of day. Remove the outdated materials. If inventory position reaches or falls below R, the order Q is made.

Table 1 explains when and how much Roemah Keboen orders to the suppliers. After the restaurant is closed, a check is made at the end of each day to remove any product that is perished before the total inventory on hand is updated. The order that is placed for a product depending on the inventory policy that is used and is discussed in detail later.

4. Equation and Formula

4.1 Periodic Review Policy

The review of removing any perished product from the shelf and updating the inventory on hand are carried out before the end of each day. This independent review is conducted at the end of the review period. For a given product, the periodic review policy is evaluated by varying the lifetime *(m)*, the review *(RP)*, and the lead time *(LT)* in order to determine the optimal order-up-to-level *S*.

The effect of each combination of level *(S)* on the system performance is studied. The order-up-to-level *S* is computed for a given service level as follows. They are the daily demand *(d)*, its mean *(Q)*, standard deviation *(σ)*, review period *(RP)*, and the lead time *(LT)*.

$$\textit{Mean demand during review period + lead time: } \mu_{RP+LT} = (RP+LT) * \mu \quad (1)$$

$$\textit{Mean demand during review period + lead time: } \sigma_{RP+LT} = (RP+LT)^{1/2}\sigma d \quad (2)$$

Since *RP* and *LT* are fixed and known, computing *S* is done under a service level of 90% using normality assumption and using Equations 1 and 2, then

$$S = \mu_{RP+LT} + (\sigma_{RP+LT} * SS) \quad (3)$$

$$\textit{Safety Stock } (SS) = \sigma_{RP+LT} * Ksl \quad (4)$$

The number of outdates and lost sales in the periodic review policy is generated by the equation below as suggested by Kouki (2010).

Lost Sales (periodic):

$$\int_{x=S}^{\infty} (x_{RP+LT} - S)\, f(x_{RP+LT})\, dx_{RP+LT} \quad (5)$$

Outdates (periodic) according to Chiu (1995):

$$\int_{x=-\infty}^{S} (S - x_{RP+LT})\, f(x_{RP+LT})\, dx_{RP+LT} \quad (6)$$

The last in periodic review policy is the total cost that is generated by the formula below

$$TC\,(RP,S) = ((A + C(\mu + E[O] - E[S] + W[O] + PE[S] / T) + HE[I] \quad (7)$$

4.2 Continuous review policy

The continuous review policy differs from the periodic review in the way the interview is checked. Every time a demand occurs, the inventory position is checked to see if it has reached the reorder point, at which point an amount *(Q)* is ordered. In addition, an inventory check is made at the end of each day to remove the perished products from the store. If the inventory position falls below the reorder point, during the check order, an order is placed to bring the inventory up to the *Q+R* position.

Since there are no other review periods to consider, the continuous review policy is evaluated by varying only the lifetime *(m)* and the lead time *(LT)*. A combination lead times similar to the periodic review case are considered. The value of the optimal order quantity *(Q)* is calculated from EOQ formula. Based on Madduri (2009), the optimal order quantity is obtained as follows.

$$Q = \sqrt{(2A\mu/h)} \quad (8)$$

The reorder point is given by

$$R = \mu_{LTD} + SS \quad (9)$$

$$Safety\ Stock\ (SS) = \sigma_{LTD} * Ksl \quad (10)$$

The outdates and lost sales number in continuous review policy are generated by the equation below as suggested by Kouki (2010).

Lost Sales (continuous):

$$\int_{x=R}^{\infty} (x-R)\, f(x_{LT})\, dx_{LT} \quad (11)$$

Outdates (continuous) according to Chiu (1995):

$$\int_{\infty}^{R+Q} (R+Q-x_{m+LT})\, f(x_{LT})\, dx_{LT}) - \int_{0}^{R} (R+Q-x_{m+LT})\, dx_{LT} \quad (12)$$

Total cost for continuous review period is generated by formula below.

$$TC\,(R,Q) = ((A+(C*Q)+PE[S]+WE[O])/E[T])+HE[I] \quad (13)$$

5. Calculation Results

5.1 Existing System

Table 2 shows the order cost, material cost, and outdates cost. There are no lost sales cost occurred because Roemah Keboen did not record how much its lost sales were in 2011. Therefore, the number of lost sales cannot be known.

Table 2. Total cost existing system

Materials	A (Rp)	*H*(RP)	*C*(Rp)	Annual *A* (Rp)	Annual *H* (Rp)	C (Rp)	*W*	*P*
Tenderloin	15,000	14,400	2,000	7,730,000	4,832,880	60,328,800	7,865.440	0
Ribs	15,000	9,000	45,000	9,275,000	6,967,300	82,673,000	6,090.550	0
Salmon	17,500	26,400	132,000	7,297,500	4,252,816	57,628,160	9,840.760	0
Oxtail	15,000	8,000	40,000	8,090,000	5,481,200	59,812,000	5,882.000	0
Chicken	10,000	5,000	24,000	6,480,000	3,529,850	42,046,560	4,732.560	0
Total				38,872,500	25,064,046	302,488,520	34,411,310	0
			Total cost	Rp 400,836,376				

5.2 Periodic Review Policy

According to Madurri (2009) the lead time and review periods are chosen such that *m>RP>LT*. In the case of Roemah Keboen, the lifetime is 4 days and lead time is one day. The feasible combination of LT and RP then equals to 1-3 chosen days. In addition, since the products are perishable, a sensitivity analysis on the order must be raised.

First, *S* and *SS* must be determined by using Equations 1-4. The results indicate the number of menus in Roemah Keboen restaurant, how much they need the materials, and the number of menus, which is multiplied by the amount of materials needed. For example, for tenderloin, it consists of kebfar wonder steak and tenderloin steak. In the review period 1, the calculation indicates the number of orders is increasing to *(S)*. For example, for kebfar wonder steak, the number is 22, and for tenderloin, the number is 18. Thus, the number of tenderloin materials that needsto be ordered is up to is 22 plus 18 then multiplied by 0.13 kg (materials needed to make that menus). After *S* and *SS* are determined, the outdates and lost sales expectation must be defined first before outdates and lost sales cost are generated. The number of outdates and lost sales are determined using equations 5 and 6, before totaling the cost of each material. The last step is to generate the total cost in every review period where holding cost, outdates cost, lost sales cost, and ordering cost are totaled (Equation 7). The total cost for the periodic policy in every period review can be seen in Table 3.

Table 3. Total cost calculation (Periodic Review Policy)

	Total Cost
Periodic Review Policy with RP 1	Rp 1,139,171,079
Periodic Review Policy with RP 2	Rp 768,066,807
Periodic Review Policy with RP 3	Rp 564,102,812

5.3 Continuous Review Policy

According to Nahmias (1982), to see that optimal order size, the Equation of $a = \min(Q, \mu*m)$ is used to ensure that no units expire. In Roemah Keboen case, the Equation becomes $a = \min(Q,\mu*4)$. The calculation in continuous review policy is quite the same as the calculation in periodic review policy. If in periodic review policy the first step indicates how much *S* and *SS*, then in continuous review policy, *Q* and *R* must be determined first by using the Equations 8 and 9. The rest to calculate how many materials

are needed because the Q and R calculation indicates the number of menus. Outdates and lost sales are determined by using Equations 11 and 12, then sum of the cost for each materials. The last step is to generate the total cost by using Equation 13. The results of the calculation of total cost can be seen in Table 4 below.

Table 4. Total cost calculation (Continuous review policy)

Materials	Total Cost
Tenderloin	Rp 74,301,916
Ribs	Rp 114,454,063
Salmon	Rp 78,511,032
Oxtail	Rp 40,086,219
Chicken	Rp 44,212,904
Total	Rp351,566,134

To choose the best solution for solving the problems in Roemah Keboen, the total cost of periodic review policy, continuous review policy, and existing system will be compared as shown in Table 5 below.

Table 5. Total cost comparison

	Total Cost
Existing System	Rp 400,836,376
Periodic Review Policy RP 1	Rp 1,139,171,079
Periodic Review Policy RP 2	Rp 768,066,807
Periodic Review Policy RP 3	Rp 564,102,812
Continuous Review Policy	Rp 351,566,134

4. Conclussion

Roemah Keboen is a restaurant company that has a problem with the amount of its main materials waste. The total amount of its waste exceeds its expectation. On the other hand, the company must not have a loss in its sales. Since the company is a service company, Roemah Keboen must always fulfil their customer demands. Therefore, the company prefers to order many materials that always lead to waste. The root cause that occurs in Roemah Keboen is that its executive chef conducted material orders and order scheduling in a subjective manner. To solve this problem, it is proposed that Roemah Keboen apply a periodic review policy with many review periods and a continuous review policy. Based on the comparison between the existing system and the proposed policies, the best method is the continuous review policy. The total cost of this policy is is cheaper than that of both the existing system and periodic review policy. With the continuous review policy, Roemah Keboen can reduce its cost up to 12%. There are some recommendations for Roemah Keboen in order to improve its inventory management. The first is to determine how much the cost and the time to order by using the proposed solution from the beginning of the month. The second is to always update its statistical sales so that the company can anticipate what to do if something wrong happens in the middle of the month. The third is to improve its marketing activity so that its customer demand can be increased and its waste materials can be decreased.

The last is to update the replenishment policy in accordance with the changes in the price of a material and cost of an order.

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