Optimization Quantity of Perishable Products Delivery Considering Total Cost Producer

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Abstract: Perishable products is product with a finite lifetime. Perishable products is an expiry date with a fixed lifetime. Expired time is a problem must be considered in planning of the finished product concerns the product safety issue when consuming and handling in food industry has its own uniqueness due to the time limit of product usage. Therefore, analyzing the number of delivery by considering the total cost producer. The research was conducted to optimize the number of product deliveries to the consumers with consideration of the total cost producer and expired product becomes reduced. The results obtained by optimizing the number of delivery based on consideration of total cost producer shows that the optimal number of delivery is 1,081 units with the total minimum cost producer of Rp. 39.894.900 / month with delivery frequency of 16 delivery / month and 0.063 month time interval. The total cost of producer can be minimized by 18.7% of the existing total cost in producer.

1 INTRODUCTION

Food and beverage industry is one of the important sectors in Indonesian economy because it is able to contribute to Gross Domestic Product (GDP). This is evident through the contribution food and beverage industry into the largest subsector of 34.42% followed by the growth of food and beverage industry in 2017 in Indonesia which is increase by 8.15% (Nafisah, *etc*, 2016). The food industry is an industry with a complex supply chain and generally has a great risk because it produces products with perishable characteristics.

Perishability is classified in two things, namely fixed lifetime and random lifetime. Perishable products is products with a finite lifetime (Joo, *etc*, 2003). Perishable goods broadly classified into two categories based on deterioration and obsolescence (Nagare and Dutta, 2012). Deterioration refers to damage, spoilage, vaporization, depletion, decay degradation and loss of potency such as pharmaceuticals and chemicals of goods. Obsolescence is value loss of a product due to the presence of a new product and a better product (Goyal and Giri, 2001). Fixed lifetime product (such as human blood used to transfusion, food expiration limit, etc) has a tend deterministic storage period, while the random lifetime scenario assumes that the shelf life at each unit product is a random variable.

Some perishable products will gradually decline in product quality from time to time (not spontaneously), deteriorate, until the product ends completely (broken / expired / unusable). Examples of products that are susceptible to deterioration in quality until they are damaged are food, fruits, vegetables, meat, medicines and medical products.

Most food stuffs, photographic films and pharmaceutical products is an expiry date with a fixed lifetime (Ge and Zhang, 2011). Any units remains unused by expire date considered outdated, and must be disposed of. Expired time is a problem must be considered in planning of the finished product concerns the product safety issue when consuming (Indrianti, 2001). Therefore handling in food industry has its own uniqueness due to the time limits of product usage.

Perishable products problem widely practiced in previous studies with different perspectives. (Puspitasari, 2016) Rosi et.al. did a research on

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hospital in Semarang to get an optimal lot size for the drugs categorized as a deathstroke-return. Another study also conducted by Ludmila et.al (Dawidowicz and Postan, 2016) with the problems of perishable products subject to deterioration during warehousing. Analyzation and controlling a perishable product to maintain size of inventory to minimizing the total cost. The same study also conducted by Dalfard and Nosratian (Dalfard and Nosratian, 2014) described a pricing constrained single-product and inventory-production model in perishable food with deterioration rate to maximizing the total profit.

However, studies on perishable inventory issues has been done before did not consider the total cost incurred by the producer in optimizing the delivery and this study aims to optimize the number of delivery with the consideration of total cost producer and expired products become reduced.

2 METHODOLOGY

The research was conducted on one of the industries producing perishable products in the form of cakes with various types. The object in this study is the total of expired products produced on SMEs. The research begins by making observations directly to SMEs to see the conditions existing in the SMEs. By making observations, will be obtained problems occurs in SMEs and will be determined Formulation of the problem according to the real condition.

Based on the formulation of the problem, determined the purpose of research as a solution in analyzing and handling these condition. Next stage, problem solving using supporting data as an input in problem solving. The data used in handling the problem of products number expired and high cost of returns in the form of the request numbers per product, product capacity, delivery frequency, product purchasing price, ordering costs, delivery costs, storage costs, and expired costs.

Based on these data, calculates the optimal number of delivery by considering the total cost producer and the number of expired products to be reduced. The calculation of the optimal number of delivery is done by several stages. The first stage is to calculate the aggregate demand. The aggregate demand is obtained by determining the conversion factor first. The conversion factor is determined by looking at the minimum raw material requirements in producing at each product.

After obtaining the number of demand in aggregate units, the next step is to determine the total delivery. Total delivery can be obtained by determining the time interval and the size of the finished pr/duct delivery lot first. The time interval is obtained from the ratio between the planning cycle (T) and the delivery frequency (n). The time interval calculation can be done using the formula (Rau, *etc*, 2004):

$$\text{Time Interval (t)} = \frac{T}{n} \quad (1)$$

And the calculation of lot size in finished product delivery is done by using formula:

$$\text{Delivery Lot Size}(q_B) = \frac{D}{\theta B}\left[e^{\theta Bt}-1\right] \quad (1)$$

D is a product demand for a month while "θB" represents the rate of damage to the finished product to the consumer. Based on these two formulas, we will get the total delivery at each delivery frequency by multiplying the delivery time interval which is obtained by the size of the finished product delivery lot.

The next step is to calculate the producer's total cost. This calculation is done to determine the total cost expenses due to many expire products and done immediately. Calculation of total cost of producer is done by using the formula:

Total Cost Producer = Setup Cost + Delivery Finished Product Cost + Storage Finished Product Cost + Expired Cost of Producer (1)

Setup cost is the cost expenses when an order is filed with the formula. Delivery cost is the cost expenses when the finished product is delivered to the consumer. Storage costs represent expenses for maintenance purposes, rental of premises, or insurance cost on products / raw materials available. And expired cost is the cost expenses because the products passed the life already (Limansyah and Lesmono, 2011). Based on the value at each cost, the total cost will be obtained for the producer and the total optimal product delivery determined by considering the minimum total cost of producer.

3 RESULT AND DISCUSSION

3.1 Aggregate Demand

Calculation of aggregate demand is done by determining the convection factor first. Based on the raw materials needed to produce each product, it is found that brownies products have the minimum requirement of raw material among other products with the total of flour 0.10 kg / product and brownies product becomes conversion factor in calculating aggregate demand. The aggregate demand is calculated by multiplying the demand for the finished product for 30 days with the conversion at each product. The calculation of aggregate demand is calculated in daily for each product for 30 days. Based on the calculation, it is found that the number of demand for finished products in aggregate demand about 17,099.3 brownies units for 30 days.

3.2 Delivery Lot Size

The calculation of the delivery lot size is obtained by determining the time interval value and size of the finished product delivery lot first. Based on the formula used in calculating the total number of delivery, it is found that the size of the finished product delivery lot with the frequency of product delivery 16 times in 30 days is 1,081 with the total delivery of the finished prodct optimally about 17,304 units of brownies.

3.3 Total Cost

The total cost calculated in this research is the total cost of producers. Total cost is obtained based on the value of other costs required in producing the product from setup costs, storage costs, delivery costs, and expired costs for products passed through life. Based on the value of these costs, it is found that the total cost for the optimal number of product delivery is Rp. 39.894.900 / month. Recapitulation of total optimal delivery and total cost producer can be seen in Table 1.

Table 1: Recapitulation of Total Optimal Delivery and Total Cost Producer.

Frequency	Time Interval	Delivery Lot Size	Total of Optimal Delivery	Total Cost
16	0,063 month	1.081 unit brownies	17.305 unit brownies	Rp. 39.894.900/month

Based on the table above, obtained that the total minimum cost of the producer is Rp. 39.894.900 / month with the delivery frequency 16 times of the delivery / month and the time interval of 0.063 months and lot size of 1,081 units brownies. The results of this study were carried out with other studies that have been conducted on the inventory of perishable products. Determination of the optimal lot size (Q) on the manufacturer that is capable of filling the total number of shipments and total producers (Puspitasari, *etc*, 2016) (Limansyah and Lesmono, 2011).

The existing condition of producer do daily delivery to agent with total delivery 30 times in a month. The producer total cost can be minimized by 18.7% of the existing total cost in producer. The existing condition delivered product every day, so cost of delivery increased.

4 CONCLUSIONS

Perishable products is an expiry date with a fixed lifetime. Expired time is a problem must be considered in planning of the finished product concerns the product safety issue when consuming and handling in food industry has its own uniqueness due to the time limit of product usage.

By optimizing the number of delivery time based on the consideration of total cost producers, it is found that total optimal delivery of 1,081 units with the total minimum cost of the producer is Rp. 39.894.900/month with delivery frequency of 16 delivery / month and 0.063 month time interval.

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