

ECONOMIC ORDER QUANTITY (EOQ) ON ADDITIONAL RAW MATERIAL INVENTORY OF PT. PANEN EMBUN KEMAKMURAN

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ABSTRACT

This study aims to determine the frequency of purchasing raw materials for Cup 220 ml and Straw optimally using the Economic Order Quantity (EOQ) method at PT. Panen Embun Kemakmuran. The type of data used is quantitative data, with the research method being qualitative. The results showed that the optimal purchase frequency for the 220 ml Cup type is 3 times and Straw 8 times in one year. The number of safety stock that must be owned by the company for 220 ml Cup is 1.503.277 and Straw 1.264.144 Pcs. The company must place a reorder or reorder point for 220 ml Cup when supplies reach 1.931.320 Pcs and Straw 1.695.596 Pcs. The total cost of inventory if PT. Panen Embun Kemakmuran using the EOQ method is Rp 139,806,429, the company can save for 220 ml Cup raw materials of Rp 56.862.105 and Straw of Rp 341.704 or overall savings of Rp 57.203.809.

Key Words: Economic Order Quantity; Inventory; Reorder Point; Safety Stock.

INTRODUCTION

The company has targets and goals to achieve; one of these goals is to get high profits by minimizing the costs incurred during the production process or in the purchase of raw materials. A common problem that often arises in companies is cost planning which is not under what is happening. This research focuses on PT. Panen Embun Kemakmuran is an industrial company engaged in processing and selling Bottled Drinking Water. However, in controlling the inventory of raw materials, PT. Panen Embun Kemakmuran is not using any analysis related to this calculation. The result of some raw materials in the warehouse experiencing a shortage of stock which has impacted the disruption of the production process at the factory.

The raw material inventory planning carried out by the company supposedly can fulfill the company's orders quickly and precisely. It will not cause excess inventory, which can result in inefficient use of funds (Darmawan et al., 2015). Economic Order Quantity (EOQ) analysis can be used to minimize the cost of the inventory. Yamit (2013:47) states that the EOQ is the number of orders that can minimize the total cost of inventory, the optimal purchase. Meanwhile, Harnanto (2012:113) said that the EOQ method is a method that can be used to determine the number of inventory purchases and minimize related costs.

The Economic Order Quantity method can minimize the out-of-stock occurrence so that it does not interfere with the ongoing production process and can save on inventory costs incurred due to the efficiency of raw material inventory within the company. This EOQ method can also be used efficiently and practically to plan how many times raw materials are purchased and in what quantity the raw materials are purchased. According to Darmawan et al. (2015), using the EOQ calculation, it will be known as the Total Inventory Cost (TIC) or the minimum total cost of the company's raw material inventory. In addition to knowing the TIC, you can also find the safety stock and the point of reordering raw materials.

According to Fahmi (2016), safety stock is the company's ability to create inventory conditions that are always safe or full of security in the hope that the company will never experience an inventory shortage. Cahyono and Jamaludin (2021) reorder point or reorder point is how companies can reorder so as not to experience a shortage of raw materials from waiting time.

Based on the object of this research, PT. Panen Embun has various types of raw materials in producing its products. However, the highest use is the type of raw material for 220 ml Cup, and Straw is the most widely used because the 220 ml Cup packaging product is the most sold. With many requests for these products, when the production process takes place, these raw materials must always be available for the process's smooth running. Therefore, it is necessary to plan and control raw materials more efficiently. An analysis with the EOQ method is needed to compare policies implemented by the company. So, the company can choose which policies are more effective and efficient in terms of spending costs from inventory.

This study aims to compare the total cost of raw material inventory using company policies using the Economic Order Quantity method to determine which is more optimal between the two policies. On the other hand, this research will determine the optimal purchase frequency and quantity the company can do for its raw material activities. This research helps to know the existing safety stock in the warehouse and the minimum inventory remaining so that when the stock starts to decrease, it must be reordered by the company.

METHODOLOGY

This study used quantitative data with a research method used a qualitative approach to describe the calculation results based on the method used. The data used secondary data in the form of inventory data for 2021, whose calculation results then be analyzed and described. Data were obtained directly from the PT. Harvest Dew Prosperity in the Finance & Accounting division. The data collection technique used in this research is the documentation technique in the form of raw material inventory data and the costs incurred for the raw materials of PT. Harvest Dew Prosperity in 2021. Data analysis techniques use Economic Order Quantity (EOQ) to calculate the number of economic orders, Total Inventory Cost (TIC) to calculate total inventory costs, Safety Stock (SS) to calculate safety stock, and Reorder Point (ROP) to calculate the reorder point.

Heizer and Barry (2015: 563) determine the amount of Economic Order Quantity using the formula:

$$EOQ = \sqrt{\frac{2.D.S}{c}} \quad (1)$$

with:

EOQ = The amount of Economic Order Quantity

D = Annual demand for inventories

S = Order cost (per order)

C = Annual Storage Cost (per unit)

Hidayat et al. (2020) determine the Total Inventory Cost (TIC) with the EOQ method using the formula:

$$TIC = \left(\frac{D}{Q^*} \times S\right) + \left(\frac{Q^*}{2} \times H\right) \quad (2)$$

with:

TIC = Total inventory cost

Q* = EOQ value

D = Estimated purchases (per periode)

S = Order cost (per order)

H = Annual Storage Cost (per unit)

Juventia & Hartanti (2016) determine the safety stock using the formula:

$$SS = SD \times Z \quad (3)$$

with:

SS = Safety Stock

SD = Standard Deviation

Z = Safety factor (Determined by the company's ability)

Cahyono and Jamaludin (2021) determine the Reorder Point using the formula:

$$ROP = (dxL) + SS \quad (4)$$

with:

d = Average usage

L = Lead Time

SS = Safety Stock

RESULT AND ANALYSIS

Data on the Inventory of additional raw materials: Cup 200 ml and Straw obtained directly from the Company, are presented in the following Table 1

Table 1. Inventory of 220 ml Cup and Straw Raw Materials in 2021

No	Month	Additional Raw Materials		
		Cup 220 ml (Pcs)	Straw (Pcs)	Total
1	January	1.780.267	4.632.816	6.413.083
2	February	772.400	3.094.704	3.867.104
3	March	270.819	2.049.360	2.320.179
4	April	2.162.463	847.488	3.009.951
5	May	2.495.464	2.081.040	4.576.504
6	June	2.761.610	1.817.232	4.578.842
7	July	4.182.825	3.038.016	7.220.841
8	August	1.978.552	2.649.888	4.628.440
9	September	1.691.342	1.369.344	3.060.686
10	October	757.640	2.578.832	3.336.472
11	November	3.219.650	2.667.728	5.887.378
12	December	877.697	4.364.528	5.242.225
Total		22.950.729	31.190.976	54.141.705
Average		1.912.561	2.599.248	4.511.809

Source: PT. Panen Embun Kemakmuran, 2021

Table 1 shows the total amount of raw material supplies for 220 ml Cup and Straw in 2021 is 54.141.705 pcs. The straw is the additional raw material with the highest amount of inventory with a total of 31.190.976 pcs, followed by 220 ml Cup, which is 22.950.729 pcs. The average monthly inventory is 4.511.809 pcs, with the average inventory of straw reaching 2.599.248 pcs per month. In comparison, the average supply of raw materials for Cup 220 ml is 1.912.561 pcs per month..

Table 2. Use of Raw Materials for 220 ml Cup and Straw in 2021

No	Month	Additional Raw Materials		Total
		Cup 220 ml (Pcs)	Straw (Pcs)	
1	January	176.800	175.968	352.768
2	February	831.019	1.368.288	2.199.307
3	March	501.745	1.045.344	1.547.089
4	April	1.204.536	1.201.226	2.405.762
5	May	577.799	571.248	1.149.047
6	June	1.425.854	1.416.139	2.841.993
7	July	1.685.523	1.659.798	3.345.321
8	August	2.759.859	2.310.733	5.070.592
9	September	1.327.210	1.283.008	2.610.218
10	October	1.973.702	1.879.312	3.853.014
11	November	3.304.490	3.175.104	6.479.594
12	December	2.331.453	2.158.032	4.489.485
	Total	18.099.990	18.244.200	36.344.190
	Average	1.508.333	1.520.350	3.028.683

Source: PT. Panen Embun Kemakmuran, 2021

Tabel 2 shows that production activities in 2021 are carried out monthly, with a total use 36.344.190 Pcs in 2021. The highest use is found in the type of raw material Straw, which is 18.244.200 Pcs with an average usage of 1.520.350 Pcs per month. Then the raw material for the 220 ml Cup reached 18.099.990 Pcs with an average monthly usage of 1.508.333 Pcs.

Tabel 3. Data Pemesanan Bahan Baku Cup 220 ml dan Straw Tahun 2021

No	Month	Additional Raw Materials		No
		Cup 220 ml (Pcs)	Straw (Pcs)	
1	January	-	-	-
2	February	1.080.000	-	1.080.000
3	March	2.016.000	-	2.016.000
4	April	1.875.600	1.804.800	3.680.400
5	May	-	-	-
6	June	1.776.600	1.152.000	2.928.600
7	July	3.106.600	2.880.000	5.986.600
8	August	126.000	1.920.000	2.046.000
9	September	1.040.000	-	1.040.000
10	October	1.040.000	3.072.000	4.112.000
11	November	5.760.000	3.264.000	9.024.000
12	December	-	3.840.000	3.840.000
	Total	17.820.800	17.932.800	35.753.600
	Average	1.980.089	2.561.829	3.575.360

Source: PT. Panen Embun Kemakmuran, 2021

Table 3 shows the total order of raw materials for Cup 220 ml and Straw by PT. Panen Embun Kemakmuran in 2021 reached 35.753.600 Pcs consisting of 17.820.800 Pcs of 220 ml Cup raw materials and 17.932.800 Pcs of straw purchases. The average quantity of raw material purchases is 3.575.360 Pcs with Cup raw materials having an average purchase of 1.980.089 Pcs, and the average purchase of Straw reaches 2.561.829 Pcs.

The order cost of additional raw materials in PT. Panen Embun Kemakmuran used a franco fee system. These costs are all charges for ordering raw materials borne by the seller or supplier, from packaging and shipping to the cost of unloading goods to the warehouse. The suppliers in deliver raw materials to PT. Panen Embun Kemakmuran does not charge any fees. In making purchases, the company pays taxes on additional raw materials. The tax is recognized as an ordering fee every time the company purchases the additional raw materials. Because of that, PT. Harvest Dew Prosperity pays VAT Input, excluding the price of raw materials.

Table 4. Order Cost of Additional Raw Materials in 2021

Cost Type	Cost (Rp)	
	Cup 220 ml	Straw
Taxes (PPN Masukan)	Rp 138.348.545	Rp 17.784.437
Total	Rp 156.132.982	

Source: PT. Panen Embun Kemakmuran, 2021

Table 4 shows the order cost of additional raw materials issued by PT is a tax fee imposed on the purchase of raw materials during 2021 which is Rp 156.132.982. Consists of order cost for Cup 220 ml of Rp 138.348.545 and Straw Rp 17.784.437.

Table 5. Storage Cost of Additional Raw Materials in 2021

Electricity Cost	
Month	Cost
January	Rp 11.664.652
February	Rp 16.843.070
March	Rp 14.262.121
April	Rp 28.238.220
May	Rp 27.556.039
June	Rp 25.777.669
July	Rp 29.330.973
August	Rp 30.653.019
September	Rp 32.458.217
October	Rp 30.509.342
November	Rp 36.158.460
December	Rp 37.561.982
Total	Rp 321.013.764
Average	Rp 26.751.147

Source: PT. Panen Embun Kemakmuran, 2021

Table 5 shows that the storage cost of additional raw materials includes only the cost of electricity. Storage costs in 2021 reached Rp 321.013.764, with an average monthly cost of Rp 26.751.147. PT. Panen Embun Kemakmuran in ordering or purchasing 220 ml Cup nine times a year, while for Straw, the company purchases seven times a year

Total Inventory Cost (TIC) of additional raw materials cup 220 mL and straw based on company policy and EOQ is presented with the following calculations:

1) TIC Cup 220 ml based on company policy:

$$TIC = \frac{D}{Q} \times S + \frac{Q}{2} \times H$$

$$TIC = \text{Rp } 138.348.541 + \text{Rp } 17.820.801$$

$$TIC = \text{Rp } 156.169.342$$

So the total inventory cost of 220 ml Cup must be borne by PT. Panen Embun Kemakmuran is Rp 156.169.342.

2) TIC Straw based on company policy

$$TIC = \frac{D}{Q} \times S + \frac{Q}{2} \times H$$

$$TIC = (17.932.800 \text{ Pcs}) / (2.561.829 \text{ Pcs}) \times \text{Rp } 2.540.634 + (2.561.829 \text{ Pcs}) / 2 \times \text{Rp } 18$$

$$TIC = \text{Rp } 17.784.435 + \text{Rp } 23.056.461$$

$$TIC = \text{Rp } 40.840.896$$

So the total inventory cost of straw must be borne by PT. Panen Embun Kemakmuran is Rp 40.840.896.

TIC value based on company policy compared with the TIC value by determining the frequency of purchases based on the EOQ method. The following results were obtained:

1) EOQ Cup 220 ml

$$EOQ = \sqrt{\frac{2 \cdot D \cdot S}{C}}$$

$$EOQ = \sqrt{\frac{2 \times 17.820.800 \times \text{Rp } 15.372.061}{\text{Rp } 18}}$$

$$EOQ = \sqrt{30.438.047.185.422}$$

$$EOQ = 5.517.069 \text{ Pcs}$$

The results show that purchasing additional raw materials Cup 220 ml is economical using the EOQ method, which is 5.517.069 Pcs.

2) EOQ Straw

$$EOQ = \sqrt{\frac{2 \cdot D \cdot S}{C}}$$

$$EOQ = \sqrt{\frac{2 \times 17.932.800 \times 2.540.634}{Rp 18}}$$

$$EOQ = \sqrt{5.062.297.932.800}$$

$$EOQ = 2.249.955 \text{ Pcs}$$

The results show that purchasing additional raw materials Straw is economical using the EOQ method, which is 2.249.955 Pcs.

Furthermore, based on the EOQ value, the frequency of purchasing raw materials was determined to be used in calculating TIC.

1) Purchasing frequency of Cup 220 ml

$$F = \frac{D}{Q^*}$$

$$F = \frac{17.820.800}{5.517.069}$$

$$F = 3$$

Based on the results above, it can be stated that the frequency of purchasing 220 ml Cup is the most economical if the company uses the EOQ method three times a year.

2) Purchasing frequency of Straw

$$F = \frac{D}{Q^*}$$

$$F = \frac{17.932.800}{2.249.955}$$

$$F = 8$$

Based on the results above, it can be stated that the frequency of purchasing Straw is the most economical if the company uses the EOQ method eight times a year.

TIC calculations are obtained with the following calculations:

1) TIC Cup 220 ml with EOQ

$$TIC = \frac{D}{Q^*} \times S + \frac{Q^*}{2} \times H$$

$$TIC = (17.820.800 \text{ Pcs}) / (5.517.069 \text{ Pcs}) \times Rp 15.372.061 + (5.517.069 \text{ Pcs}) / 2 \times Rp 18$$

$$TIC = Rp 49.653.616 + Rp 49.653.621$$

$$TIC = Rp 99.307.237$$

Total inventory cost of Cup 220 ml if the company used the EOQ method is Rp 99.307.237.

2) TIC Straw with EOQ

$$TIC = \frac{D}{Q^*} \times S + \frac{Q^*}{2} \times H$$

$$TIC = (17.932.800 \text{ Pcs}) / (2.249.955 \text{ Pcs}) \times Rp 2.540.634 + (2.249.955 \text{ Pcs}) / 2 \times Rp 18$$

$$TIC = Rp 20.249.597 + Rp 20.249.595$$

$$TIC = Rp 40.499.192$$

Total inventory cost of Straw if the company used the EOQ method is Rp 40.499.192

Based on the results of previous calculations, it can be seen that the 220 ml Cup inventory costs incurred by the company amounted to Rp 156.169.342, while the total inventory costs incurred by the company when using the EOQ method is Rp 99.307.237, thus, the savings amounted to Rp 56.862.105. Meanwhile, the total cost of Straw inventory issued by the company is Rp 40.840.896, and if the total cost of Straw inventory issued by the company when using EOQ is Rp 40.499.192, it can be seen that the company is savings Rp 341.704. Based on these results, the saving total if PT. Panen Embun Kemakmuran used the EOQ method to control its raw materials inventory is Rp 57.203.809.

Furthermore, the value of Safety Stock is determined by the additional raw materials for 220 mL Cup and Straw:

1) Safety Stock of Cup 220 ml

The standard deviation of the 220 ml Cup is 911,077 Pcs. PT. Panen Embun Kemakmuran implements the supplies is 95% of demand. Z score based on normal table is 1,65:

$$SS = SD \times Z$$

$$SS = 911.077 \times 1,65$$

$$SS = 1.503.277,05 \text{ Pcs (1.503.277 Pcs)}$$

2) Safety Stock of Straw

The standard deviation of the Straw is 766.148 Pcs. PT. Panen Embun Kemakmuran implements the supplies is 95% of demand. Z score based on normal table is 1,65

$$SS = SD \times Z$$

$$SS = 766.148 \times 1,65$$

$$SS = 1.264.144,2 \text{ Pcs (1.264.144 Pcs)}$$

Reorder Point on additional raw materials Cup 220 mL and Straw was calculated as follows:

1) ROP Cup 220 ml

$$ROP = (dxL) + SS$$

$$ROP = (61.149 \times 7) + 1.503.277$$

$$ROP = 428.043 + 1.503.277$$

$$ROP = 1.931.320 \text{ Pcs}$$

Based on the results, ROP calculations indicate that PT. Panen Embun Kemakmuran must reorder for 220 ml Cup if the raw material inventory is 1.931.320 Pcs.

2) ROP Straw

$$ROP = (dxL) + SS$$

$$ROP = (61.636 \times 7) + 1.264.144$$

$$ROP = 431.452 + 1.264.144$$

$$ROP = 1.695.596 \text{ Pcs}$$

Based on the results, ROP calculations indicate that PT. Panen Embun Kemakmuran must place a reorder for straw if the raw material inventory is 1.695.596 Pcs.

DISCUSSION AND CONCLUSION

The frequency of purchasing raw materials when the company used the EOQ method for 220 ml Cup raw materials is three times a year and Straw eight times a year. The total cost of inventory if PT. Panen Embun Kemakmuran using the EOQ method is Rp. 139.806.429. Meanwhile, based on the company's policy Rp 197.010.238, 3. The following table is a comparison of TIC on Company Policy and the EOQ Method

Table 6. Comparison of TIC on Company Policy and the EOQ Method

	Company's Policy		EOQ Method	
	Cup 220 ml	Straw	Cup 220 ml	Straw
TIC	Rp 156.169.342	Rp 40.840.896	Rp 99.307.237	Rp 40.499.192

Source: Data processed by the author, 2022

Based on the result calculations, it can be seen that 220 ml Cup inventory cost incurred by the company is Rp 156.169.342, while the total inventory cost using the EOQ method is Rp 99.307.237, thus, the saving is Rp 56.862.105. Meanwhile, the total inventory cost of straw incurred by the company is Rp 40.840.896, while the total inventory cost using EOQ method is Rp 40.499.192, thus the saving is Rp 341.704.

The overall savings if PT. Panen Embun Kemakmuran used EOQ method to control the additional raw material inventory in 2021 is Rp 57.203.809. With the Safety Stock for 220 ml Cup is 1503277 pcs, and reorder Point is 1931320 pcs. Then, safety stock for straw is 1264144 pcs with reorder point is 1695596 pcs.

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