Determination of lead time arrival of raw materials optimal vannamei shrimp at PT. XYZ Makassar

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Abstract. Inventory control is the efforts made by a company so that the production process can be optimally fulfilled with the smallest possible risk. The problem of raw material requirements and costs incurred for the production process is very important, because with the existence of raw materials the production process can run smoothly. This study aims to determine the amount of economical Vannamei shrimp raw material inventory and to know when the order should be done with PT. XYZ Makassar. Where the need for raw materials in 2017 was 1,855,558 kg. Therefore, companies must control the supply of raw materials that are economical and efficient in order to meet the production process for each specified period, determine the optimal waiting time for the arrival of raw materials and determine the quantity of orders that are economical. Based on the results of research determining the optimal waiting time for arrival of raw materials at PT XYZ Makassar using the Economic Order Quantity (EOQ) method, obtained an economical raw material inventory of 20,672 kg per message with a total inventory cost of Rp.136,586,577 each time message. With the Stock Out Cost (SOC) and Extra Carrying Cost (ECC) method, the optimal waiting time for arrival of raw materials is 3 days with a minimum cost of Rp. 1,836,979,830 and with the Reorder Point (ROP) method, the results of the order are made again at the level inventory in warehouse 18,555 kg.

1. Introduction
1.1. Background
PT. XYZ Makassar is a company engaged in shrimp processing and freezing. One of the raw materials used is Vannamei shrimp obtained from suppliers in Barru, Pangkajenne and the Islands, Makassar, Bulukumba, Kendari, Palu and Luwu which have been partners for so long. The company's finished products are only exported to Japan and not distributed domestically, so the quality of the seafood products is prioritized. To produce quality products, synergy between humans or workers is needed, with the material, technology and the environment.

According to Agus Ahyari (2003), The continuity of the production process within a company will be influenced by various factors including capital, technology, methods, inventory and labor [1]. One important part in the production process is inventory. Inventory control is a very important problem because the amount of inventory will determine or influence the smooth production process as well as the effectiveness and efficiency of each company. This inventory needs to be controlled regularly and periodically, starting from raw materials, semi-finished materials, to finished goods. Raw material inventory must be able to meet production needs, because if raw material inventory cannot be met, it will hamper the production process. Sometimes raw materials are still quite a lot but purchases have been made so that it results in the accumulation of raw materials in warehouses. This can reduce the
quality of ingredients and will increase storage costs. Conversely, delays in ordering raw materials have an impact on not meeting the needs of products ordered by consumers. So it is very important to control inventory well.

PT. XYZ Makassar processes frozen raw shrimp which will be exported to Japan using the main raw material, Vannamei shrimp. Where the availability of main raw materials is to support the continuity of the production process within the company. From the results of the study there are obstacles in the company that is no consideration of determining the optimal waiting time for the arrival of raw materials, which results in companies often experiencing excess and lack of raw materials so that it impedes the company’s production process.

Based on data from the amount of Vannamei shrimp raw material needs in 2017 reached 1,855,558 kg, while in 2016 the needs of Vannamei shrimp raw materials only reached 1,790,728 kg or an increase of 3.62%. To ensure the smooth and sustainable production, the company needs to control inventory by determining the optimal amount of raw material inventory using the Economic Order Quantity (EOQ) method. Next, According to Gitosudarmo Indriyo (2002) make an optimal waiting time for the arrival of raw materials by calculating re-order points using the calculation of the cost of Stock Out Cost (SOC) and Extra Carrying Cost (ECC) [2]. Stock Out Cost (SOC), which is the costs that have to be incurred due to the delay in the arrival of raw materials and Extra Carrying Cost (ECC), the costs that have to be incurred because the raw materials come too early. By using this method it is expected to be able to provide the best solution for the company where it can be set for an economical number of orders and when the company has to reorder.

1.2. Formulation of the problem
Based on the background that has been described previously, the formulation of the problem in this study is what is the waiting time (lead time) for the optimal arrival of Vannamei shrimp raw material at PT. XYZ Makassar

1.3. Research purposes
Based on the formulation of the problem, the purpose of this research is to determine the lead time for the optimal arrival of Vannamei shrimp raw material at PT. XYZ Makassar

2. Research Methodology
The data obtained is then observed and processed to obtain the desired results, and the data processing analysis stages are:

2.1. EOQ Method
a. According to T. Hani Handoko (1995), Calculate the number of orders in a single message by using the EOQ method [3].

\[ EOQ = \sqrt{\frac{2DS}{H}} \]

Where,
- EOQ : Optimum number of units per-order
- S : Ordering cost for each order
- D : Annual demand in unit for the inventory item
- H : Holding or carrying cost per unit per year

b. According to Heizer and Render (2005), Calculates the total cost (TIC) of inventory based on the EOQ method [4].

\[ TIC = S \times \frac{D}{Q} + H \times \frac{Q}{2} \]
Where,

- **TIC**: Total inventory costs
- **Q**: Number of unit per order
- **S**: Ordering cost for each order
- **D**: Annual demand in unit for the inventory item
- **H**: Holding or carrying cost per unit per year

c. According to Gitosudarmo Indriyo (2002), Calculate the ratio of Extra Carrying Cost (ECC) and Stock Out Cost (SOC) [2].

Extra Carrying Cost can be searched using the formula:

\[ \text{ECC} = \frac{D}{\text{number of days/year} \times \text{storage costs}} \]

Stock Out Cost can be searched using the formula:

\[ \text{SOC} = \text{Need for raw materials per day} \times \text{Stock out cost} \]

d. According to Sofyan Assauri (1998), Calculate the value of ROP (Reorder Point) [5].

\[ \text{Reorder Point} = (LD \times AU) + SS \]

Where,

- **LD**: Lead time or waiting time
- **AU**: Average unit or average usage during the unit waiting time
- **SS**: Safety stock

### 3. Results and Discussion

#### 3.1. Data Collection Results

As explained in the previous chapter, that to discuss problems in the company is used the calculation of Extra Carrying Cost (ECC) and Stock Out Cost (SOC). PT. XYZ Makassar procures Vannamei shrimp raw materials which are closely related to the production process by ordering from suppliers who have become partners. The purchase of raw materials in 2017 amounted to 1,855,558 kg per month on the average is 154,630 kg at a price of Rp. 66,000 per Kg.

| Name of goods     | Unit | Order Amount (Kg) | Price/Kg |
|-------------------|------|-------------------|----------|
| Vannamei Shrimp   | Kg   | 1.855.558         | Rp 66.000|

Source: PT. XYZ Makassar, 2017

The cost of raw material inventory that must be borne by PT. XYZ Makassar includes:

#### 3.1.1. Ordering Cost. The details of the costs incurred by the company for each order of raw materials are as follows:

| No. | Cost Type            | Cost incurred            |
|-----|----------------------|--------------------------|
| 1.  | Transportation costs | IDR 540,000 per Ordering |
| 2.  | Cost of Telephone    | IDR 40,000 per ordering  |
3. Cost of Listing IDR 50,000 per ordering
4. Cost of Unloading Raw Materials IDR 130,000 per ordering

**Total** IDR 760,000 per ordering

Source: PT. XYZ Makassar, 2017

In table 2, it can be seen that the cost that must be incurred by the company in making each order during 2017 is IDR 760,000. These costs are the accumulation of costs incurred by the company in making each order.

3.1.2. **Storage Cost.** The cost of storing raw materials at PT XYZ Makassar is calculated in the form of a percentage that is the percentage of inventory value. The amount of raw material storage costs set by the company is 10% of the inventory price per kilogram per year and is a calculation of some storage costs such as packing costs, electricity usage, ice usage, warehouse administration costs, and reserve costs for possible damage to goods in inventory.

| Table 3. Storage costs per kg |
|-----------------------------|
| Cost                       | Amount       |
| Price per Kg, IDR 66.000 x 10% | IDR 6,600/kg |
| Total                      | IDR 6,600/kg/day |

Source : PT XYZ Makassar Tahun 2017

In the table 3, it can be seen that the storage costs incurred by the company is IDR.6,600 per kg per day.

| Table 4. List of Raw Material Needs at PT XYZ Makassar period for 2017 |
|-------------------------|-------------------|-----------------|
| No. | Month   | Amount (Kg) |
|-----|---------|-------------|
| 1   | January | 123,949     |
| 2   | February| 105,284     |
| 3   | March   | 160,929     |
| 4   | April   | 181,534     |
| 5   | May     | 140,236     |
| 6   | June    | 128,236     |
| 7   | July    | 180,236     |
| 8   | August  | 192,295     |
| 9   | September | 150,372    |
| 10  | October | 162,109     |
| 11  | November| 190,075     |
| 12  | December| 140,304     |
|     | Total   | 1,855,558   |

Source : PT XYZ Makassar Tahun 2017

Based on table 4 it can be seen that the total company's raw material needs in 2017 were 1,855,588 kg with an average number of orders of 154,630 kg, the cost of ordering each time ordering was Rp. 760,000 and storage costs required are Rp. 6,600.- per kg / day with a storage time of 3 days. Then from the data above the total inventory cost (TIC) of the company can be seen as follows:
Where,

\[ TIC = \frac{D}{Q} S + \frac{Q}{2} H \]

\( TIC \): Total inventory costs
\( Q \): The number of items each time an order = 154,630 kg
\( S \): Order cost for each order = Rp. 760,000
\( D \): Annual demand for supplies = 1,855,588 kg
\( H \): Per-unit storage cost = Rp. 6,600.

\[ TIC = \frac{1,855,588 \text{ kg}}{154,630 \text{ kg}} \times \frac{760,000}{154,630} + \frac{154,630 \text{ kg}}{2} \times \frac{6,600}{2} \]

\[ TIC = \text{Rp} \ 519,399.138 \]

3.2. Data processing

3.2.1. Calculation of inventory control using the EOQ method. Inventory analysis of the EOQ method uses QM For Windows V5 software for more precise accuracy and completeness of the calculation results including frequency and total cost based on the EOQ results in table 5 below

| Parameter                              | Value  | Parameter                              | Value   |
|----------------------------------------|--------|----------------------------------------|---------|
| Demand rate (D)                        | 1855558| Optimal order quantity (Q*)            | 20672.22|
| Setup/ordering cost                   | 760000 | Maximum Inventory level (lmax)         | 20672.22|
| Holding/carrying cost                 | 6600   | Average Inventory                      | 10336.11|
| Unit cost                              | 6600   | Order per period (year)                | 89.76   |
|                                        |        | Annual Setup Cost                      | 68218320|
|                                        |        | Annual Holding Cost                    | 68218320|
| Total Inventory (holding + setup cost) | 136436600|                                        |         |
| Unit cost                              | 122466800000 |
| Total cost                            | 122603300000 |

Source: QM Data Processing for Windows V5

From table 5 above we get the EOQ value of 20,672.22 kg which means that the number of economic orders that must be ordered is 20,672 kg / one-time order and the results of orders per period (year) are 89.76 times means that the order frequency in one period is 90 times order.

3.2.2. Determination of TIC (Total Inventory Cost). The TIC formula is as follows:

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

Where,

\( TIC \): Total inventory costs
\( Q \): The number of items each time an order = 20,672 kg
\( S \): Order fee for each order = Rp. 760,000
\( D \): Annual demand for supplies = 1,855,588 kg
\( H \): Per-unit storage cost = Rp. 6,600
3.2.3. Comparison of the company's total inventory costs (TIC) with the total inventory costs (TIC) using the EOQ method

| Comparative Variable        | Company    | EOQ        |
|-----------------------------|------------|------------|
| Number of orders one time order | 154,630 kg | 20,672 kg  |
| The frequency of ordering   | 12 times   | 90 times   |

| TIC                         | IDR 519,399,138 | IDR 136,586,577 |

Source: Data processed 2019

3.2.4. Comparison of Stock Out Cost (SOC) and Extra Carrying Cost (ECC).

To calculate the reorder point, it must carefully calculate the timeliness because if the order regresses somewhat later than that time it will add to the purchase of basic materials or so-called Stock Out Cost (SOC), and if too early the extra carrying cost (ECC) cost is calculated. Determination of Lead Time with minimum costs. From 10 historical data about Lead Time in 2017 showing the probability is:

| Lead Time | Frequency | Probability |
|-----------|-----------|-------------|
| 2 days    | 2 times   | 20%         |
| 3 days    | 5 times   | 50%         |
| 4 days    | 3 times   | 30%         |
| 10 times  |           |             |

Calculation of Extra Carrying Cost (costs incurred due to arrival of raw material orders too early)

\[
ECC = \frac{D}{\text{number of days / year} \times \text{storage costs}}
\]

\[
ECC = \frac{1,855,588 \text{ kg} \times Rp\ 6,600}{300 \text{ hari}} = Rp\ 40,822,936/\text{day}
\]

Calculation of Stock Out Costs (costs incurred for the purchase of substitute / substitution basic materials will come later than the coming order).

The need for raw goods per day:

\[
\frac{1,855,588 \text{ kg}}{300 \text{ days}} = 6,185 \text{ kg/day}
\]

Stock Out Cost = Rp 6,600/kg

\[
\text{SOC} = \text{Need for Raw Goods per day} \times \text{Stock out cost}
\]

\[
\text{SOC} = 6,185 \text{ kg} \times 6,600 = Rp\ 40,821,100/\text{day}
\]

3.2.5. Calculation Reorder Point (ROP)

Needs per day \(= (1,855,588)/300=6,185\ \text{kg}\)

Needs during lead time \(= 3 \times 6,185 \text{ kg} = 18,555 \text{ kg}\)
ROP = Need during lead time + safety stock = 18,555 kg + 0 = 18,555 kg

3.3 Discussion
From the results of ECC and SOC calculations can be compared as follows:

| Lead Time | ECC    | SOC    |
|-----------|--------|--------|
|           | Every order (Rp) | For one year (90 x messages) (Rp) | Each Order (Rp) | For one year (90 x messages) (Rp) | Total (Rp) |
| 2 day     | 0      | 44,903,100 | 4,041,279,000 | 4,041,279,000 |
| 3 day     | 8,164,587 | 734,812,830 | 12,246,300 | 1,102,167,000 | 1,836,979,830 |
| 4 day     | 36,740,642 | 3,306,657,780 | - | - | 3,306,657,780 |

Source: Data processed

From the comparison of ECC and SOC calculation results it is known that the Lead Time with the most minimal cost is 3 days with a total cost of Rp. 1,836,979,830, thus it can be determined 3 days before the raw materials run out the company must re-order raw materials. Order back (ROP) is done when the inventory in the warehouse is at the level of 18,555 kg.

4. Conclusion
Based on the calculation of raw material inventory at PT. Bogatama Marinusa Makassar can be known to the company in 2017 ordering raw materials with the number of raw materials each time ordering 154,630 kg with a total inventory cost of Rp. 519,399,138. While the optimal purchase quantity using the Economic Order Quantity (EOQ) method is 20,672 kg per message with a total inventory cost of Rp. 136,586,577 every time you order.

From the results of ECC and SOC calculations it can be concluded that the optimal waiting time or Lead Time is 3 days with a minimum total cost of Rp. 1,836,979,830. Thus it can be determined, 3 days before the raw materials run out the company must re-order with the inventory level at the warehouse at 18,555 kg.

5. Suggestion
Based on the conclusions from the calculation results, the company needs to apply the Economic Order Quantity (EOQ) calculation and determine the optimal waiting time by using the Stock Out Cost (SOC) and Extra Carrying Cost (ECC) cost calculations to determine the economic order quantity and when the company must make reorder (Reorder) for the sake of smooth production at the company.

References
[1] Ahyari A 2003 Manajemen Bahan-Bahan: Efisiensi Persediaan Bahan (Yogyakarta: BPFE Yogyakarta)
[2] Gitosudarmo I 2002 Manajemen Keuangan Edisi 4 (Yogyakarta: BPFE)
[3] Handoko and Hani T 1995 Manajemen Produksi dan Operasi (Jakarta: Grasindo)
[4] Jay H and Barry R 2005 Operations Management Edisi Ketujuh (Jakarta: Salemba Empat)
[5] Assauri S 1998 Manajemen Produksi dan Operasi ed BPFE–UGM (Yogyakarta)