Fulfillment of Customer Orders with Distribution Improvement

Nurhayati Sembiring, Ukurta Tarigan and Syahputra Siallagan
Faculty of Engineering, University of Sumatera Utara, Indonesia
E-mail: nurhayatipandia68@usu.ac.id

Abstract. A company engaged in shrimp feed production, has 4 physical distribution networks, namely: PT. JWL, PT. SWS, PT. BWP, and, CV. WS. Logistics problems at the company is not achieving the fulfillment of customer orders with the right amount and the right time. This is due to the company's inefficient inventory, distribution and transportation systems. The method used to solve inventory problems is to set safety stock. To solve distribution problems use Distribution Requirement Planning, Reorder points and determine the order frequency. Through a series of processing and problem solving steps, it is known that the total needs that must be met by the company is 10,502,308 kg with a safety stock of 132,860 tons.

1. Introduction
Logistics is not new in the industrial field. Throughout the history, logistics has been used to address various types of human needs and send them to every part of the region. And as time goes on, this science is constantly updated to get the right system. Logistics plays a vital role in the industrial system. To create competitiveness, companies no longer rely on traditional ways of distributing products. Scientific development and innovation in distribution management enable companies to create efficiency, something that is very important to customers today [1,2]. Distribution is a network of companies that work together to create and deliver a product to the end user. These companies usually include suppliers, factories, distributors, stores or retail, as well as supporting companies such as logistics services companies. At a distribution there are usually 3 types of that must be managed. The first is the flow of goods flowing from upstream to downstream. An example is raw material sent from suppliers to the logistics department. After the raw materials have been produced, they are sent to the distributor, then to the retailer, finally to the end user. The second is the flow of money and the like that flows from downstream to upstream. The third is the flow of information that can occur from upstream to downstream or vice versa. Information about the supply of production capacity owned by suppliers is also often needed by the factory. The distribution of the products give influence on the cost chain of corner and customer satisfaction exceeds a good distribution can be obtained at low cost and increased customer satisfaction [3,4,5].

The observed company engaged in shrimp feed production produces two types of feed, namely crumble and pellet. This company has 3 distribution centers, namely PT. JWL, PT. SWS, PT. BWP, and 1 wholesaler, CV. WS. The main issue in the company is the non fluency of supply products to its distribution network. There are a number of discrepancies of products generated by the products needed by DC and wholesaler. It influenced of advantages and disadvantages from the supply of products in the warehouse.
2. Research methods
This study is classified as a descriptive study (descriptive research), means a research that does solving current problem systematically and factually based on existing data. The object of the research observed was the final order quantity from 3 distribution centers and 1 wholesaler. The following are the elements of the object of research observed:

- Central Facility Supply = PT. CPP
- Distribution Center 1 = PT. JWL
- Distribution Center 2 = PT. SWS
- Distribution Center 3 = PT. BWP
- Wholesaler = CV. WS

Figure 1 shows the schema of this research:

![Figure 1. Schema Of The Research.](image)

Research begins with forecasting the customer demands to know the number of optimal demands. Through the calculation of the economic order quantity and order frequency, combine with the amount of safety stock, then distribution requirement planning, can be achieved. The output of this whole process is the amount of consumer demand i.e. the distribution centre and wholesaler [6,7].

3. Results and discussion
3.1 Analysis of demand forecasting
Forecasting Method in this research using Time Series forecasting method. Historical data on the request of each Distribution Center and Wholesaler serve as the basis of forecasting for the next period.

| Distributor    | Total (kg) |
|----------------|------------|
| PT. JWL        | 4,567.557  |
| PT. SWS        | 2,737.425  |
| PT. BWP        | 1,034.893  |
| CV. WS         | 1,034.893  |

3.2 Analysis of the calculation of the Economic Order Quantity
At this stage we must know the Initial stock, Booking Fee, Delivery Lead Time of the company. The initial stock is the number of products contained in the storage section of each distribution center. The number of initial stock for each distribution center can be seen in table 2.

| Dealer Name   | I-9001 | I-682 | I-683 | I-683-SP | I-683-S |
|---------------|--------|-------|-------|----------|---------|
| PT. JWL       | 2,155  | 3,307 | 3,603 | 3,881    | 1,454   |
Prices for each shrimp feed product produced by the company differs depending on raw feed prices, raw material composition, complexity of production processing, and others [8,9]. Ordering fee is the amount that must be paid by the distributor to order shrimp feed from the producer includes invoice fees, telephone costs, transportation and loading and unloading costs shown in the table 3.

| Distributor | Invoice Fee (Rp/Order) | Phone Expenses, etc (Rp/Order) | Delivery Costs and Unloading (Rp/SENT) | Total Costs |
|-------------|------------------------|---------------------------------|----------------------------------------|-------------|
| PT. JWL     | 5.000                  | 15.000                          | 2,500.000                              | 3,520.000   |
| PT. SWS     | 5.000                  | 15.000                          | 2,000.000                              | 2,020.000   |
| PT. BWP     | 5.000                  | 15.000                          | 2,200.000                              | 2,220.000   |
| CV. WS      | 5.000                  | 15.000                          | 750.000                                | 770.000     |

Distribution lead time data is used as variable change costs based on the length of delivery from producer to consumer. The lead time from producers to each distributor is shown in Table 4.

| Distribution Center | Lead Time (Days) |
|---------------------|------------------|
| PT. JWL             | 4                |
| PT. SWS             | 2                |
| PT. BWP             | 2                |
| CV. WS              |                  |
|                      |                  |

 EOQ calculation is done to get the number of economical orders ordered by distribution Center and wholesaler is based on demand forecasting that has been carried [10,11,12]. The formula is:

\[ Q = \sqrt{\frac{AD}{h}} \]  

(1)

The results of EOQ calculations for each distributor for each shrimp feed product are as follows:

|                   | I- 9001 | I- 682 | I- 683 | I- 683-SP | I- 683-S | Total     |
|-------------------|---------|--------|--------|-----------|----------|-----------|
| PT. JWL           | 11.860  | 24.607 | 41.769 | 36.069    | 37.229   | 151,607   |
| PT. SWS           | 7.039   | 13.329 | 22.594 | 25.277    | 20.148   | 88,387    |
| PT. BWP           | 5.935   | 13.267 | 20.958 | 23.208    | 18.934   | 82,302    |
| PT. WS            | 2.539   | 5.631  | 9.303  | 8.841     | 7.350    | 33,664    |

Safety stock in this system is a reference for reorder to fulfill forecasting results. Calculation of safety stock can be calculated using the formula:

\[ \text{Safety Stock} = S \times Z \]  

(2)
Table 6. Total safety stock obtained (Safety Stock).

| Distributor | Total  |
|-------------|--------|
| PT. JWL     | 70,329 |
| PT. SWS     | 61,896 |
| PT. BWP     | 41,972 |
| CV. WS      | 33,664 |
| PT. CP      | 132,860|

3.3. Distribution Requirement Planning

DRP planning can be arranged for each DC and wholesalers on a periodical time bucket, because the lead time does not exceed 1 month [10,11,12]. Distribution requirement planning sheet is obtained after going through several stages, namely:

1. Gross Requirement: the number of requests to be distributed obtained from the results of forecasting
2. Schedule receipt: the number of receipts that have been scheduled from the previous PORel results
3. Project On Hand: projection of the amount of inventory that still exists at a certain time phased.
4. PoRec (Plan Order Receipt): the number of orders scheduled for the period needed
5. PoRel (Plan Order Release): order plan after the lead time information is taken into account. Lead time is the grace period between ordering and receiving orders.

\[
\text{PoH periode 1} = \text{SRi} + \text{PoH(i-1)} - \text{Gri} \\
\text{PoH periode 2} = \text{PoH(i-1)} + \text{PoReci} - \text{Gri}
\]

The Table below is an example for distribution requirement planning calculation (PT JWL and PT SWS)

Table 7. Distribution Requirement Planning Sheet PT JWL.

| Post Due | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| GR       | 221 | 221 | 221 | 221 | 214 | 214 | 214 | 214 | 165 | 165 | 165 | 165 | 165 | 200 |
| SR       | 379 |     |     |     |     |     |     |     |     |     |     |     |     |     |
| PoH      | 59  | 217 | 375 | 154 | 312 | 98  | 263 | 49  | 214 | 49  | 263 | 98  | 312 | 147 | 326 |
| PoRec    | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   |
| PoRel    | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   |

Table 8. Distribution Requirement Planning Sheet PT JWL.

| Post Due | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| GR       | 200 | 200 | 200 | 158 | 158 | 158 | 158 | 158 | 200 | 200 | 200 | 200 | 200 | 205 |
| SR       | 326 | 126 | 305 | 105 | 326 | 168 | 389 | 231 | 73  | 252 | 52  | 231 | 410 | 205 |
| PoH      | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 0   | 379 | 0   | 379 | 379 | 0   | 379 |
| PoRec    | 379 | 0   | 379 | 0   | 379 | 0   | 0   | 379 | 0   | 379 | 379 | 0   | 379 | 0   |
| PoRel    | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   | 379 | 0   |

For another Distribution centre and wholesaler, the stages of calculations also exactly the same. By using the Distribution Requirement Planning method, the frequency of the number of orders is obtained from 417 orders to 136 orders with a percentage decrease of 67.38%.
3.4 Analysis of downstream information

Downstream chain information that occurs at the company will be explained as follows [13,14,15].

1. Chain 1-2: Manufacturer - Distribution Center
   The flow that occurs starts from PT. CPP as a manufacturer. The products are distributed to 3 distribution centers, namely: PT. JWL, PT. SWS, and PT. BWP. Products from the manufacturer are sent to the distribution center via land transportation using truck load.

2. Chain 1-3: Manufacturer - Wholesaler
   The next party who is an unofficial distributor of PT. CPP is CV. SWS is a wholesaler. Products from manufacturers are sent to wholesalers via land transportation using truck load.

3. Chain 1-2-4: Manufacturer - Distribution Center - Costumer
   In this chain stream the distribution center is PT. JWL, PT. SWS and PT. BWP sells products in each marketing area. Then the information in the form of sales and the remaining stock of each distribution center is then returned to PT. CPP as a consideration of consumer demand data in each marketing location.

4. Chain 1-3-4: Manufacturer - Wholesaler - Customer
   At this wholesaler, CV WS sells products in the marketing area and then re-orders PT. CPP based on requested requirements. Downstream information Flows that occur in the logistics sector of PT. CPP is described as follows:

![Downstream Information Flows Diagram](image)

**Figure 2.** Downstream information Flows.

4. Conclusion

The conclusions obtained from the research are as follows:

1. In this study the EOQ method was used to determine the number of companies that were right
2. The number of requests obtained using forecasting techniques is 4,567,587 kg for PT. JWL, 2,737,425 kg for PT. SWS, 2,162,433 for PT. BWP, and 1,034,893 kg for CV. WS
3. The total number of optimum orders obtained from the economic order quantity method for each distribution center is 151,607 tons for PT. JWL, 88,387 tons for PT. SWS, 82,302 tons for PT. BWP. And the total order quantity for wholesaler CV. The WS is 33,664 tons.
4. Total safety stock obtained (Safety Stock) is 70,329 tons for PT. JWL, 61,896 tons for PT. SWS, 41,972 tons for PT. BWP, 33,664 tons for CV. WS. Total Safety stock for PT. CP is 132,860 tons
5. Total demand that must be met by PT. CP is equal to 10,502.308 kg
References

[1] Inan O, Bahar S, H. Zumrut T. 2010. A New Approach In Logistics Management: Just In Time-Logistics (JIT-L). Anadolu University.

[2] Lukasz H, Piotr C, Roman D, Marek F. 2009. Comparative Analysis Of Selected Concepts Of Managing Material Flows In Distribution Logistics. Poznan School of Logistics.

[3] Siddharth Mahajan, Krishna Sundar Diatha. 2018. Minimizing the Discounted Average Cost Under Continuous Compounding in the EOQ Models with a Regular Product and a Perishable Product. Indian Institute of Management.

[4] Jozef F, Pawel R. 2014. Integrated Logistics Management System For Operation Of Machinery And Equipment. Poznan University of Technology.

[5] R. Kavitha P, K. Senbagam. 2018. An EOQ Inventory Model for Two Parameter Weibull Deterioration with Quadratic Time Dependent Demand and Shortages. CSI College of Engineering

[6] Leila S, Valentinas N. 2014. The Impact Of Port Logistics systems On A Country’s Competitiveness. Kaunas University of Technology

[7] Isiyaku A, Babangida S. 2018. An Inventory Model for Deteriorating Items with Generalised Exponential Decreasing Demand, Constant Holding Cost and Time-Varying Deterioration Rate. Kaduna Polytechnic.

[8] Chandra Sekhar J V D, Balasubramanian V. 2012. DRP: A Novel Approach for Requirement Planning in Supply Chain Management. School of Computing Science and Engineering VIT University.

[9] Nassibeh J, Mostafa Z, Akbar A. T, Masood R. 2018. Designing Sustainable Distribution Network in Pharmaceutical Supply Chain: A Case Study. Shahid Beheshti University.

[10] Bhidara S, Isnani D, Agus W. 2017. An EOQ Model with a Random Defective Supply Batch and Backorder Policy. Brawijaya University.

[11] Sarbjit Singh. 2017. Optimal Ordering Policy for Deteriorating Items Having Constant Demand and Deterioration Rate. Institute of Management Technology.

[12] Lakshmana K, S. Nallusamy, V. Ramakrishnan. 2018. Proposed Inventory Management Model To Improve The Supply Chain Efficiency And Surplus In Textile Industry. Arba Minch University.

[13] John Maleyeff. 2014. Quantifying the Value of Flexibility in Supply Chains for High-Risk Products. Rensselaer Polytechnic Institute

[14] Chirinda Ngoni. 2012. The development of a materials requirements planning model applicable in Small & Medium Enterprise manufacturing companies in Zimbabwe.

[15] Ferdoush S, Md. Mamun H, Bishwajit Banik P, Zurina Binti H. 2014. Demand and Supply Planning in Retail Operations. Universiti Utara Malaysia (UUM).