Inventory Control System Using Distribution Requirement Planning (DRP) (Case Study: Food Company)

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Abstract. Distribution and inventory are two major components that causes total cost of the product become high. Those two components are not categorized in to the process that added value to the product. This research use Distribution Requirement Planning (DRP) to find the right quantity and short replenishment time in inventory decision that manufacture industries faced to supply their own Distribution Centers and Warehouses in food Company. DRP giving the lower total distribution cost than actual cost. It is because DRP supply products at each Distribution Centers and Warehouses in a minimum quantity using Economic Order Quantity. It also using the similar concept with Material Requirement Planning to find the right delivery time so that it can minimize the total inventory time in The supply chain. DRP can be used to solve the inventory and distribution problem in multi echelon supply chain. From this research, using historical data, DRP gave the minimum total distribution and inventory cost than the initial scenario that company used. Based on DRP result, The total Inventory and Distribution Cost from January to December 2019 is 481.251.325.4.

Key words — Inventory control, EOQ, DRP.

1. Introduction

In manufacturing industries, availability is the main factor that can support continuity of the production process [2]. Availability that is mentioned here can be machines, materials, work in process products or end products. Company should has the right plan to control their inventory so that the production can run as it should be in a lower cost. Cost components here are Inventory and Distribution Costs. Inventory cost consists of Purchasing cost, ordering cost, and holding cost while distribution cost consists of vehicle rent cost and fuel cost [11].

The Major problems of inventory control that the manufacture industries faced are how to obtain the minimum inventory and also in a short replenishment of the stock time. Some inventory control mechanism has been proposed in order to control inventory [18]. Such as Economic Order Quantity (EOQ)[5, [17], and [3], Economic Order Interval (EOI) [8] and [15], Economic Production Quantity (EPQ) [9] and [16], Material Requirement Planning (MRP) [1] and [13], And the last one is Distribution requirement planning (DRP)[7], [4], and [12].

PT. Heinz ABC Indonesia (HAI) is a manufacturing industry that produce food and beverages. This Company produce Soy Souce in a variety of volume among them are 135 ml and 275 ml. Based on preliminary investigation, that company has faced some problems in determining the optimal quantity
and time to deliver their product to their Distribution Centers (DCs). And also from their DCs to their Warehouses using their own land transportation vehicles. This research aims to solve the problem using DRP. DRP method can be used to handle of an inventory problem in multiechelon distribution environment [14].

2. Literature Review

2.1 Inventory Control System

Based on [5], inventory is a number of products or items that should be available at a certain place and time in a company. There are a lot of ways that can be used to control inventory position in a company. The first one is Economic Order Quantity (EOQ). EOQ use demand to determine the optimal order size and minimal stock level that can be used as a signals to place an order. The second one is Economic Order Interval (EOI). EOI determine the optimal order interval based on given demand pattern. The third one is Economic Production Quantity (EPQ). EPQ using a similar concept with EOQ but the product in EPQ is not purchased from the other company but produced in-house. The fourth one is Material Requirement Planning (MRP) that planned inventory lotsize so they are time phased when they are needed from a product to the detailed of the product components. And the last one is Distribution requirement planning (DRP).

2.2 Distribution Requirement Planning System

Distribution requirement planning (DRP) is one type of inventory control system. DRP is a method of a handling stock replenishment in multiechelon distribution environment [19]. DRP applies time-phased logic to products in a distribution network in a manner similar to the way Material Requirement Planning (MRP) applies it to the sub-assembly and component of a products in a manufacturing bill of material network [12]. DRP is an “Implosion” process which applies centralized push system in inventory distribution management from the lowest levels of a network to the central distribution center (DC), while MRP is an “Explosion” from Master production schedule (MPS) to the scheduling of the product components [20]. General concept of DRP can be shown in Figure 1.

![Figure 1. Distribution Requirement Planning Concept][12]

DRP can be used to anticipate future demand by planning at each level in the distribution network. This method can be used to predict problems before it happened. This also can give a broader paradigm to the decision maker to solve an inventory problem in the distribution network. For manufacturing company that producing and selling their on product in their own distribution network, DRP performance can be improved by using MRP and DRP together that can be shown in Figure 2.

![Figure 2. MRP and DRP Integration][12]
DRP Algorithm:

1. Netting

Projected on-hand is an on-hand inventory. It can be calculated using formulation below:

\[
\text{Projected on Hand (t)} = (\text{On Hand (t-1)} + \text{Scheduled Receipt (t)} + \text{Planned Order Receipt(t)} - \text{Gross Requirement (t)})
\] (1)

Net Requirement can be calculated using formulation below:

\[
\text{Net Requirement (t)} = (\text{Gross Requirement (t)} + \text{Safety Stock}) - (\text{Scheduled Receipt (t)} + \text{Projected on Hand (t-1)})
\] (2)

2. Lotting

Lotting is the process to find the order or production lot size in every network distribution. There are several lotting method. In this research, EOQ is used. Lotting in DRP represented by plan order receipt (Porec). Planned order receipt (Porec) is a Net Requirement that has been adjusted according to the Lot size order or production.

3. Offsetting

Offsetting is an order quantity that is planned to be ordered in the planned time period. Offsetting in DRP represented by plan order release (Porel). Porel is a Porec that has been adjusted according to the Lead time order or production.

4. Explosion

Total inventory and distribution cost can be obtained using formulation below:

\[
\text{Total Inventory and Distribution Cost} = \text{Ordering Cost} + \text{Holding Cost} + \text{Delivery Cost}
\] (3)

2.3 Economic Order Quantity

Economic order quantity (EOQ) is one of the Lot sizing Method. EOQ is the order that can minimizes the total inventory cost. If the stockouts are not permitted, the EOQ can be shown in Equation 4 below:

\[
\text{EOQ} = \left(\frac{2CR}{P}\right)^{0.5}
\] (4)

Where

\[
C = \text{Ordering cost per order} \\
P = \text{Purchase cost of a product or item} \\
R = \text{Annual demand in units} \\
F = \text{Annual holding cost as a fraction of unit cost}
\]

3. Methodology

In this research, DRP system is used to solve the problem. DRP mechanism can be shown in Figure 3.

![Figure 3. DRP Mechanism](image-url)
4. Result and Discussion

4.1 Total Inventory and Distribution Cost in 2018

From Table 1, it can be shown that total inventory and distribution cost using DRP is lower than actual inventory and distribution cost. Therefore, DRP is used in this research to calculate demand and distribution cost in 2019.

| Actual Inventory and Distribution Cost (Rp) | DRP Method (Rp) |
|-------------------------------------------|-----------------|
| Rp.585,788,454,5                          | Rp.465,606,631,75 |

4.2 Total Inventory and Distribution Cost using DRP in 2019

From Table 2 below, it can be shown that the total inventory and distribution cost using DRP Method is 481,251,325,4 from January to December 2019.

| Distribution Network | Product  |
|----------------------|----------|
|                      | Kecap Manis ABC 135ml | Kecap Manis ABC 275ml |
| Level 2              |                      |                     |
| Warehouse Malang     | 12,611,542.92        | 18,457,342.99       |
| Warehouse Kediri     | 18,594,903.51        | 18,342,492.62       |
| Warehouse Jombang    | 16,658,667.75        | 16,519,770.43       |
| Warehouse Magelang   | 15,816,918.38        | 17,273,573.15       |
| Warehouse Cilacap    | 17,754,759.27        | 16,807,683.5        |
| Warehouse Kalideres  | 12,375,060.53        | 9,166,801,952       |
| Warehouse Sukabumi   | 16,521,884.34        | 17,195,336.78       |
| **Total Cost**       | **481,251,325,4**    |                     |

5. Conclusion

Distribution Requirement Planning (DRP) giving the lower total distribution cost than actual cost. It is because DRP supply products at each Distribution Centers and Warehouses in a minimum quantity using Economic Order Quantit. It also adopt Material Requirement Planning Concept to find the right delivery time so that it can minimize the total inventory and distribution cost in The Supply chain. From this research, using historical data, DRP gave the minimum total distribution and inventory cost than the initial scenario that company used. Based on DRP result, The total Inventory and Distribution Cost from January to December 2019 is 481,251,325,4.

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