Production Stock Optimization in PEL Plant Schneider Electric Manufacturing Batam

Puji Lestari[1]*, I Gede Agus Widyadana[2]

Abstract: Schneider Electric Manufacturing Batam is a company in an electrical field that has an issue about inventory control; especially Stock L. Stock L is a stock of raw materials that are in the production area. This research heads on searching the optimal value of Stock L as the first step to reduce the causes and determine the suitable days of inventory for PEL. Finished goods that are on PEL control are classified into their families and the optimal value of Stock L is obtained using base stock level method and company calculation. Both these methods are not significantly different from its Two Sample T-Test result. Using base stock level, the value of Stock L can be reduced about 60.59% while using company calculation, the reduction of Stock L is about 63.42%. The suitable DIN for PEL is about 3 days.

Keywords: Inventory Control, Base Stock Level, Days of Inventory

Introduction

Schneider Electric Manufacturing Batam (SEMB) is a company that focuses on the electrical industry. SEMB has a warehouse called BLP (Batam Logistic Platform) and three production plants. The plants are Sensor, PEM (Production Electro Mechanic), and PEL (Production Electronic). Each plant produces the products differently. Raw materials from suppliers will be stored in the warehouse and will be sent to each plant if there is a demand for production.

Products of PEL Plant are classified into three types (i.e., motion and drive, automation, and PCBA (Printed Circuit Board Assembly)). The raw materials for these products are mostly delivered based on OFO (Order for Order). The plant lets the warehouse know the production needs on Transfer Order and warehouse will deliver those materials. Raw materials at production area are called Stock L.

The current Stock L in PEL is about 34,951,986 units and the average daily demand is about 729,451 units. So, the actual Stock L can cover the production for 48 days. Generally, the Stock L must not exceed the necessary quantity for three-days-production to say that the Stock L is healthy. But in fact, the Stock L in PEL can cover more of three days production. This parameter indicate the stock at PEL production area is unhealthy and it becomes an issue to management.

[1,2] Fakultas Teknologi Industri, Program Studi Teknik Industri, Universitas Kristen Petra. Jl. Siwalankerto 121-131, Surabaya 60236. Email: ms.pujilestari@gmail.com, gedeaw@gmail.com
* Corresponding Author

Method

Inventory refers to the materials in stock [1]. Inventory represents those items which are either stocked for sale or they are in the production processes or they are in form of materials, which are yet to be utilized. One of the reasons for keeping stock is to stabilize production. The inventory (raw materials and components) should be made available to the production in spite of the fluctuating demand. The inventory is also kept to meet demand during the replenishment period.

Establishing inventory control system in an organization is the best way to avoid running out or overstock. In other words, company profitability depends on the inventory policies that are dependent on the following costs below [2].

Ordering cost, also called setup cost or replenishment cost that represents the administrative cost of ordering or producing materials or products.

Holding cost sometimes called the storage cost or carrying cost. This cost arises due to a holding of stock of materials. The costs include the capital, space, insurance, protection, and the taxes.

Shortage cost, also called the cost of unsatisfied demand that represent the cost that is charged because the demand (commodity required) exceeds the available stock.

Fixed Order Quantity Model

Fixed order quantity model is also called Q-model or economic order quantity (EOQ). This model is used to maintain an item in-stock and a certain number of units (same amount each order) must be ordered when the inventory position goes down to a critical

level. The fixed order quantity model is triggered by an event where the event may take place at any time, depending on the demand [3]. The inventory is continuously monitored.

EOQ model concerns about two things, how much to order (the order quantity) and when to place an order. The purpose of this model is minimizing the total cost of inventory. The decision about how much to order depends on holding cost and ordering cost. As the order quantity increases, the holding cost also increases while the ordering cost decreases. This model (EOQ) helps in balancing both of these costs. The formulas that are used in this model can be seen in Equation (1), Equation (2), and Equation (3).

$$EOQ = \sqrt{\frac{2 \times A \times D}{H}} \quad (1)$$

$$N = \frac{D}{EOQ} \quad (2)$$

$$T = \frac{365}{N} \quad (3)$$

Where,

EOQ: Optimal order quantity

N : Optimal number of orders

T : Optimal order interval in days

A : Setup cost or cost of placing an order

D : Total units purchased or produced in a year

H : Annual holding cost per unit

Fixed Time Period Model

Fixed time period model is also referred as periodic review system, fixed order interval system or P-model. Similar to Q-model, this model is also used to maintain an item in stock and ready to be used. P-model is trigged by time where placing order is limited, only at certain intervals of time. The order quantity varies from period to period, depending on the usage rates. This inventory model requires a higher safety stock than on fixed order quantity system. The safety stock must protect against stock out during review period itself as well as during the lead time from placing an order to receiving the order. The formulas that are used in fixed time period model are shown in Equation 4 and Equation 5.

$$Q = (\bar{D} \times (T + L)) + Safety\ Stock - I \quad (4)$$

$$Safety\ Stock = z \times \sigma_{T+L} \quad (5)$$

Where,

Q : Quantity to be ordered

T : The number of days between reviews

L : Lead time in days

$\bar{D}$: Forecast average daily demand

z : Number of standard deviation for a specified service probability

σ_{T+L} : Standard deviation of demand over the review and lead time

I : Current inventory position

Result and Discussion

The current Stock L is compared with the net requirement of 3 days production to satisfy February demand. The requirement of each material is obtained based on Bill of Materials (BOM) while the data of Stock L that are used in this comparison are SOH February 1st. It is used to know whether the on-hand inventory in early February exceeds the 3 days production to cover February demand or not. The excess material is classified into their family and compared to define the families that have greater impact to Stock L.

Using Pareto rule, there are 13 families that cause the higher value of Stock L and will be on focus in this research. For these 13 families, the current Stock L for 13 families can cover 8 days of production (days of inventory).

Optimal Stock L in this research is calculated in two ways, using base stock level method and using company calculation. The base stock level will become a maximum level for keeping material at production area. On the other hand, the company calculates the maximum value of Stock L for each product family. This calculation is based on sales forecast for April 2017 – March 2018. The calculation for each method can be found in the next sub-chapter.

Base Stock Level Method

The base stock level is a maximum level in keeping stock. The number of periods between orders (T^*), lead time (L), average (D) and standard deviation (STD) of demand, and the percentage there is no stop line are obtained data in this calculation. Warehouse needs a day as the longest duration from placing an order until the materials are ready at production area. The management wants the production runs 95%, so there is only 5% chance there is a stop line (z value = 1.64).

The average and standard deviation of demand are obtained using the forecast of monthly sales in a year (April 2017 – March 2018). The number of periods between orders is also called the review period. When the review period comes, an order is placed. Before calculating the base stock level, the review period must be determined first.

The cost of an order is USD 1.89 while the holding cost is about USD 0.00251 per unit per day. The demand is about 36,851 units per day. Using EOQ concepts, the optimal review period is about a day.

$$T^* = \sqrt{\frac{2 \times Ordering\ Cost}{Demand \times Holding\ Cost}}$$

$$T^* = \sqrt{\frac{2 \times 1.87}{36851 \times 0.00251}}$$

$$T^* = 0.20\ day \approx 1\ day$$

Table 1. Result

	Current Condition	Base Stock Level Method (USD)	Company Calculation (USD)
Percentage Decrease	-	60.59%	63.42%
Days of Inventory	8 days	3 days	3 days

After all of the data are obtained, the calculation using base stock level can be done. The base stock level calculation is divided into two steps. Determining the base stock level of each finished good is the first step. The following step is determining the base stock level of each material. The base stock level of each material is done by exploring the Bill of Materials. End product with reference 84870700 will be an example in this calculation.
The average of the monthly forecast from April 2017 to March 2018 for this reference is 654 units while the number of working days is 24 days. From these data, the average daily forecast is about 28 units with standard deviation about 2.89 units.

$$S = \left(\overline{D} \times (T + L)\right) + (z \times STD \times \sqrt{T + L})$$
$$S = \left(\overline{28} \times (1 + 1)\right) + (1.64 \times 2.89 \times \sqrt{1 + 1})$$
$$S = 62.72\ units \approx 63\ units$$

From calculation using base stock level method, the base stock for reference 84870700 is about 63 units. This number indicates that PEL just only can hold materials to produce about 63 units of this reference (84870700) at maximum. It is also used to determine the maximum quantity of its composing materials. The net requirement to produce 63 units is the base stock for its composing materials.
The comparison is done between Stock L value currently (based on initial data on SOH February 1st) and Stock L value as the result of the base stock level method. The value of each family mostly decreases but the values increases for two families. This condition happens because the demand for this family is high but it is not supported by the material availability at production area. But totally, there is a cut in Stock L value about 60.59% (See Table 1).

Company Calculation

This calculation uses data of sales forecast in determining the maximum value for each product family. The total amount of average sales forecast is obtained and classified into their product family. This monthly sales forecast is available from April 2017 to March 2018.
Company calculation is done on finished good level while base stock level method is done on material level. The average sales forecast for each family in a month is obtained. The working days in SEMB in a month are 24 days. So, the daily sales in SEMB for this family is equal too the ratio of the average sales forecast and the working days in a month. The maximum value in keeping materials for that family is about three time of the daily sales forecast. This value is same as keeping materials for three days sales. As explained in the previous chapter, three days production is a maximum standard of SEMB in keeping a healthy stock and this calculation (using company calculation) is based on this standard.
The calculation is done for all 13 families. The result shows that current Stock L value exceeds the requirement of three days sales. Only a family needs additional materials at production area in order to cover three days sales. At the end, using company method, the value of Stock L is able to decrease about 63.42% (See Table 1).

Days of Inventory

Days of Inventory (DIN) is a parameter in knowing how long stock was kept before they are used for production. DIN is a ratio of total stock and average daily demand. The DIN for each method can be seen in Table 1.
Table 1 shows the days of inventory from company calculation are 3 days and using the base stock level method, the days of inventory are also 3 days. Thus, the days of inventory that suitable for PEL condition are 3 days. It is same as the standard of SEMB in keeping healthy stock. It means the standard is suitable for PEL although the processes in PEL are different from the other plants.

Suggestions

The operator has to daily check the Stock L of some parts that have been rejected but have not yet updated to the system. It could be done by using formula or function "IF" on Excel. The operator should download the Stock L status daily. If the Stock L quantity is greater than the reject quantity, there is a parameter to draw operator's attention. It will be easier to the operator, so that they can be updated to the system immediately. The probability of missing to update some rejects although there is Stock L can also be reduced.

Management also has to re-check the database about materials' SPQ (Standard Packing Quantity) so there is no discrepancy between the database and the real condition. It can be done by SPQ cycle checking. Some parts that have a high SPQ on the system becomes the priority to be checked first. Those data are compared with the actual packaging from its suppliers. This suggestion could reduce the probability of excess delivery from warehouse to plant.

On the other hand, the plant needs to return the excess materials caused by SPQ system to warehouse (based on the chosen method in determining the maximum level of Stock L). But to reduce the transportation cost (back and forth), the plant needs to have a temporary location for excess materials caused by SPQ system (the balance stock). So, the excess material will be kept at the temporary location for a day. If those excess materials are not needed for production within a day, those materials are just returned to warehouse.

Some parts that are inactive or have no demand are still at production area. To determine the better action for no demand and non-active materials, the consumptions history for 2 past years are checked. If those materials are used for past 2 years, those materials must be returned and kept at warehouse BLP. If those materials are not used for past 2 years, those materials could be sold to the other companies or scraped. For parts that have no consumption data for past 2 years, the decision is on the forecast. If those materials have forecast to be used for the next time, those materials could be returned and kept at warehouse.

To prevent the no demand and non-active materials are at production area, cycle checking could be done. Once the Bill of Materials for a reference (finished goods) is changed, the materials that are not used anymore must be checked at production area. Those materials must be executed by returning those materials to warehouse BLP. These action can reduce the quantity of non-used materials at production area.

Reducing the value of Stock L can be done by proposing some OFO material to be Kanban material. It could happen because the replenishment lead time (from placing an order until the materials are delivered) is shorter because the Kanban materials are stored at Kanban warehouse in the plant. So, the quantity of material that is held at production area can also be diminishing. Actually, in addition to OFO, SEMB has already implemented Kanban for some materials. Proposing to be Kanban materials in SEMB, there are some considerations. They are usage, consumption velocity, safety, dimension, and quality.

Conclusion

Schneider Electric Manufacturing Batam is a company that runs on the electrical field. Schneider Electric Manufacturing Batam would like to know the optimal level of stock that could be held or kept at production area. The calculation for the optimal solution is done by using the base stock level method and company method. Using the base stock level, the value Stock L (13 families that are on focus in this research) could be reduced about 60.59% while using company calculation, the reduction of Stock L value is about 63.42%. The result of Two-Sample-T Test shows that both methods are not significantly different, so management could choose one of them. The days of inventory that suitable for PEL condition are about 3 days.

References

1. Kumar, S. A., & Suresh, N., *Operations Management.* New Delhi: New Age International (P) Ltd., Publishers, 2009.
2. Murthy, P. R., *Operations Research* (Second ed.). New Delhi: New Age International (P) Limited, Publisher, 2007.
3. Jacobs, F. R., & Chase, R. B., *Operations and Supply Chain Management: The Core* (3rd ed.). McGraw-Hill Education, 2012.