Synchronization of production and sales target through pull inventory management policy

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Abstract. The aim of this research is to resolve high inventory problem at RBI Cileungsi warehouse due to the imbalance flow between production outputs compared to sales realization. As an attempt to synchronize these flows we will analyse sales realization data as a representation of customer demand and determine the optimal inventory policy to meet them. Analysis will be conducted to three SKUs which had high investment value. P inventory models will be implemented and then evaluated against current condition to determine their financial benefit. Evaluation suggested that the proposed policy would give total savings of Rp. 780,667,909.97 for the first SKU, Rp. 35,361,072.53 for the second SKU and Rp. 136,729,725.19 for the third SKU. These results lead to the conclusions that the proposed policy should be further considered to be applied to other SKUs.

Keywords: inventory, pull system, P model

1. Introduction
Reckitt Benckiser (RB) is one of the leaders among health and hygiene consumer product manufacturer. Their business spans across 60 countries and one of them is located in Indonesia. To support their business, RB uses 22.002 m² warehouses. The warehouses are bar soap warehouse and house hold/personal care warehouse each of them serves bar soap and house hold/personal care production department. At each warehouse, the area is divided in to two, the raw material and packaging material area and the finished goods area where they keep their final product.

Observation shows that during several last periods, inventory stockpile accumulates to a number that is significantly high (see fig 1). Figure 1 tells us that for almost half month of operation, on hand inventory is always above the warehouse capacity (the inbound is always higher than the outbound) and the next half month the situation is reversed, and in general on hand inventory is always high throughout the month. A lot of inventories are then placed along the warehouse aisle (see fig 2).

The inventory stockpile accumulation indicates a high capital cost. In addition, this accumulation also has a direct impact on the operational activities in the warehouse, such as the difficulty to move material handling equipment to enter the aisles during pickup process. Sometimes the implementation of a simple picking rule such, as FIFO (First in First Out) or FEFO (First Expired First Out) is waived, because picker will tend to simplify their job by picking the inventory stocked up on the aisle. If this case continues, the company will be facing a great risk of having expired products.

Interviews revealed an in line information with the inventory profile in figure 1, i.e unbalanced inbound and outbound flows. Production department states that they get production plan straight from marketing target. This target is set by optimistic scenario that the market would absorb the production output. Warehouse data shows that this target cannot be met. The monthly sales are still lower than the
production output. If this continues, then potential warehouse problems as described previously will emerge.

**Figure 1.** Inventory on Hand Profile.

**Figure 2.** Inventory stockpile located on aisle.

The description above shows that there is gap between production target and the sales realization. Sales tend to be lower than the production output, thus resulting high level of inventory. Theoretically, this problem can be solved through a proper sales and operation planning (S&OP), where all the parties involved such as the production function, marketing and warehouse get together and discuss the problem dynamic faced by each then try to solved them systemically [1]. A production plan that is based on a particular target (push system) is good as long as the market is able to absorb them, but if that is not the case then there will be risks of inventory stockpile.

This study recommends gradual synchronization between production plan and sales targets. The first attempt to gradually synchronize them would be the determination of inventory policies based on real demand. These policies would then be proposed as basis for production planning.
There are several models of inventory policies. For pull system conditions [2] states that there is a model perpetual review (Q model) and periodic review (P model). What distinguishes between the two models is that in the Q model, the inventory level becomes the trigger (signal) on when inventory needs to be replenished, while in P model, inventory replenishment is done periodically, each time interval (T*) is reached.

We will propose P model as a model of inventory management policy. Using this model, adjustments to production planning that take place periodically will be easier to do. The study was conducted by considering 3 variants of product occupying the A class inventory. Classification is based on the frequency of use and value of the product, so it can be concluded that the products that exist in A class are product with high investment value and the most absorbed by the market. The three product variants are Vanish Pouch 450 ml, Dettol Liquid 100 ml NUTN and Dettol 450 ml Lasting F COR.

2. Methods
The design of inventory policy will be done in three stages. The first stage is data collection and processing, the second is determining the policy decision variables and the last stage is comparative and managerial impact analysis on the proposed policy. These three stages are described more detail in the following paragraphs.

Stage 1, is the stage of data collection and processing. Based on P model, data requirements are the product demand, production length and the costs associated with the production setup and planning process, holding cost and shortage cost. The flow of data collection and processing are depicted in figure 3.

![Data Collection and Processing Flow](image)

Figure 3. Data Collection and Processing Flow.

The data we gathered are summarized on table 1. To better understand the data, we give the notation below:

- $D$: Product demand (unit/year)
- $S$: Demand standard deviation (unit/year)
- $L$: Production lead time (year)
- $A$: Production planning and setup cost (Rp/setup)
- $p$: Production cost (Rp/unit)
- $h$: Holding cost (Rp/unit/year)
- $c_u$: Lost sales cost (Rp/unit)
Table 1. Demand and Inventory Cost Data.

| Variable | Vanish Pouch 450 ml (unit) | Dettol Liquid 100 ml (unit) | Dettol 450 ml (unit) |
|----------|-----------------------------|-----------------------------|-----------------------|
| D        | 106,369,00                  | 31,062.00                   | 15,546.00             |
| S        | 7,885.00                    | 5,776.00                    | 6,129.00              |
| L        | 0.03                        | 0.03                        | 0.03                  |
| A        | 325,245.38                  | 325,245.38                  | 325,245.38            |
| p        | 45,315.24                   | 125,382.50                  | 248,590.52            |
| h        | 49,608.57                   | 134,479.87                  | 265,080.36            |
| c_u      | 107,096.76                  | 372,806.50                  | 340,718.48            |

These variables are then used to determine the decision variables on P model. The goal is to minimize the total inventory cost as denoted on equation (1).

\[ O_T = O_p + O_{ps} + O_s + O_k \]  

where,  
\[ O_p : \text{Total production cost (Rp)} \]  
\[ O_{ps} : \text{Total production planning and setup cost (Rp)} \]  
\[ O_s : \text{Total holding cost (Rp)} \]  
\[ O_k : \text{Total shortage cost (Rp)} \]

Each of the total cost above will be calculated using equation (2), (3), (4), dan (5). [3].

\[ O_p = Dp \]  
\[ O_{ps} = \frac{A}{T} \]  
\[ O_s = h \left( R - D_L - \frac{T D}{2} + N \right) \]  
\[ O_k = \frac{c_u N}{T} \]

where,  
\[ N = S \sqrt{T + L} \left[ f(z_\alpha) - z_\alpha \psi(z_\alpha) \right] \]

and,  
\[ T : \text{Inventory review period (year)} \]  
\[ R : \text{Maximum inventory covering for T and L period (unit)} \]  
\[ f(z_\alpha) : \text{Normal distribution ordinate value for a certain } \alpha \]  
\[ \psi(z_\alpha) : \text{Normal distribution partial expectation for a certain } \alpha \]

The second stage is the determination of decision variables. The decision variables are the review period (T) and the maximum inventory level allowed on the warehouse to enable the company to provide customer demand (R). We use equation (7) and (8) to get these values.

\[ T^* = \frac{2 A}{Dh} \]  
\[ R = D(T + L) + z_\alpha S \sqrt{T + L} \]
On the third stage we compare the total inventory cost for the proposed and actual system, along with their service level. On this stage we also conducted an analysis on the managerial impact of the proposed method implementation.

3. Results and Discussion

We present inventory decision variables based on the P model and the expected inventory cost associated with it on table 1. The real cost occur on existing system is given on table 2.

| Vanish Pouch 450 ml | Dettol Liquid 100 ml | Dettol 450 ml |
|---------------------|----------------------|--------------|
| T                   | 0.011                | 0.012        | 0.013        |
| α                   | 0.999                | 0.999        | 0.999        |
| Zα                  | 3.990                | 3.990        | 3.990        |
| R                   | 10.750.453           | 6.069.406    | 5.706.950    |
| Op                  | 4.820.136.763.560    | 3.894.631.215.000 | 3.864.588.223.920 |
| Ops                 | 29.293.850.625       | 26.063.570.979 | 25.887.414.519 |
| Os                  | 345.721.072.686      | 664.842.626.091 | 1.363.304.972.370 |
| Ok                  | 926.731.283          | 2.137.443.677 | 2.060.903.869 |
| Ot                  | 5.196.078.418.154    | 4.587.674.855.747 | 5.255.841.514.678 |

| Cost Component | Vanish Pouch 450 ml | Dettol Liquid 100 ml | Dettol 450 ml |
|----------------|---------------------|----------------------|--------------|
| Op             | 5.403.615.793.80    | 4.136.494.057.50    | 4.583.512.007.76 |
| Ops            | 26.344.875.78       | 13.009.815.20       | 8.781.625.26  |
| Os             | 546.785.658.54      | 473.532.055.58      | 800.277.606.85 |
| Ok             | 0                   | 0                    | 0             |
| Ot             | 5.976.746.328.12    | 4.623.035.928.28    | 5.392.571.239.87 |

By comparing the cost value on table 2 and 3, we know that the implementation of the proposed method will bring cost saving to the company. The savings will be much more significant if the proposed method is applied to other products sitting on A class of inventory classification.

The implication of this proposed policy is that the company must shift from push to pull production. The determination of product replenishment is conducted on periodic base at T (see table 2) and production target are formulated to brought back inventory to the maximum level (R). These should be conducted as the first attempt to synchronize production output and the sales pull to minimize inventory stockpile.

4. Conclusions

The proposed policy has proven to give financial benefit, the savings are Rp. 780,667,909.97 for Vanish Pouch 450 ml, Rp. 35,361,072.53 for Dettol Liquid 100 ml and Rp. 136,729,725.19 for Dettol 450 ml. The savings are approximately 10% compared to the current total cost. The review period differ between the three product, but not too significant (see table 2 for the T value). To ease the implementation process, the company can consider conducting the inventory review on the same time.
by taking the smallest T among the three product. Demand data record should be conducted continuously as input for policy evaluation. The main idea of this proposed solution is to see the problem at hand through systematic approach.

5. References
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