Sustainable industrial systems through strategic laboratory equipment industry

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Abstract. This paper conveys the theoretical perspectives of sustainable industrial systems through Strategic Laboratory Equipment Industry, within scope of PT. Promedika Sejahtera (PPS). PT Promedika Sejahtera is a company engaged in the laboratory equipment industry, that need its strategic touch on its Strategic Laboratory Equipment. Products sold by the company are Oxygen, Medical Equipment, Ultraviolet System, Activated Carbon Filter, Pempers, and Underpad. Products that exist in the company are not in their own production in the production from abroad. PT Promedika Sejahtera merely sell the laboratory equipment. Yet, the company has various types of consumers namely hospitals, hospital cooperatives, pharmacies, factories, and water equipment RO shops. In this paper, strategic laboratory equipment industry refers specifically to inventory within the supply chain management perspectives. This paper constitutes collaboration with other papers on Economic Order Quantity (EOQ), Re-Order Point (ROP), and Safety Stock (SS), that convolutes Forecasting, ABC Analysis, and Partial Least Square (PLS). Yet, this paper refers to its focus merely on Forecasting, Demand Pattern, Exponential Smoothing and EOQ. As part of conclusion, this paper conveys several highlighted remarks. Those remarks refer to ABC Analysis. The grouping of goods using ABC Analysis Method is divided into three groups: A with 80% priority, group B with 20% priority and group C with 10% priority. The number of goods in group A is 12 items, group B 18 item type and group C are 30 items of goods. Forecasting demand required by the Company for 2018 based on priority group A can be done using the Double Exponential Smoothing (Holt's) Method because the pattern pattern possessed from the previous year's sales data has no seasonal but has a random trend. The results of these calculations can be seen from the table of existing research results. Ultimately, Future research is deemed indispensable within novelty purpose for the industrial system sustainability within Strategic Laboratory Equipment Industry.

Keywords: Sustainability, Strategic Laboratory Equipment, Inventory, Supply Chain, Partial Least Square,
1. Introduction

Today many companies require companies to have many strategies to survive in the industry today. That requirement applies to PT. Promedika Sejahtera (PPS) that requires sustainable industrial systems through Strategic Laboratory Equipment for its stakeholders. In conditions of high competition between companies, the strategic within development of science and technology increasingly sophisticated greatly affect the development of industrial sector companies. Companies generally have the same goal of gaining profits, can survive from other competitors, and able to grow following the development of existing markets. In achieving this the company must be able to manage the resources owned properly and well. That is because, the problem of procurement of goods is one of the problems that often experienced by the company and important problems that must be faced by the company to be able to balance with production activities.

PT Promedika Sejahtera is a company engaged in the laboratory equipment industry, that need its strategic touch on its Strategic Laboratory Equipment. Products sold by the company are Oxygen, Medical Equipment, Ultraviolet System, Activated Carbon Filter, Pampers, and Underpad. Products that exist in the company are not in their own production in the production from abroad. PT Promedika Sejahtera merely sell the laboratory equipment. Yet, the company has various types of consumers namely hospitals, hospital cooperatives, pharmacies, factories, and water equipment RO shops.

PT Promedika Sejahtera has been established since 2000 so that this company has a lot of experience in sales. Because this company only sells medical equipment and its products must be ordered from abroad to make this company having problems in ordering goods. Sometimes PT Promedika Sejahtera can not meet customer demand due to the increasing demand for the product. Therefore, companies should make good inventory procurement using ABC analysis. ABC analysis was introduced by HF Dickie in 1950, this ABC analysis uses a Pareto principle that focuses inventory control on high value rather than low. According to the name of the ABC analysis, this method is divided into three classes of supplies that are A, B, and C. Class A is a stock that has a high Rupiah. Class B has a moderate rupiah value. Whereas, class C has inventory with small rupiah value. The classification of the classes is used to find out what items of goods should be more attention than others. Therefore, careful management of health equipment in group A.

Inventory control mostly uses mathematical modeling with Economic Order Quantity (EOQ). EOQ is used to find out the optimal number of orders. Other mathematical modeling is to use demand forecasting and reorder time or Re-Order Point (ROP) in order to estimate safety stock. Safety stock is the minimum inventory amount of items in the company that is useful to avoid the occurrence of running out of goods (stock out).

Based on this background, this research is very important to analyze the procurement system of health equipment by using ABC analysis to solve the existing problems and strive for the procurement of health equipment at PT Promedika Sejahtera optimally. This paper conveys several remarks refer to ABC Analysis, in which this Analysis Method is divided into three groups: A with 80% priority, group B with 20% priority and group C with 10% priority. The number of goods in group A is 12 items, group B 18 item type and group C are 30 items of goods. Forecasting demand required by the Company for 2018 based on priority group A can be done using the Double Exponential Smoothing (Holt’s) Method

1.1 Forecasting

Demand forecast is one of the key challenges in supply chain management, as strategic enablers in strategic laboratory equipment. Inappropriate predictions lead to overstocks and respective markdowns and disgruntled customers. To ensure supply chain performance against prediction inaccuracies, important countermeasures are to make safety stocks [1].

Forecasting can be classified several dimensions, one of which is time horizon. Here are the forecasting related horizons in forecasting operations planning. First, Short-term forecasting is very important for everyday planning. Short-term estimates, usually measured in days or weeks, are required for inventory management, production plans that may come from material requirements.
planning systems, and resource demand planning. Scheduling shifts may require worker estimates or availability and preference. Second, Medium-term forecasting is measured in weeks or months.

Sales patterns for product families, requirements, worker availability, and resource requirements are the usual medium-term forecasting problems faced in operations management. Third, Long-term forecasting and production decisions are part of the company's overall manufacturing strategy. One example is long-term capacity planning needs. When demand is expected to increase, the company must plan the construction of new facilities or retrofitting existing facilities with new technology [2].

There are five characteristics of forecasting: First, *Forecast is not always true*. The forecast method is one of the most overlooked methods of almost any forecasting method. Resource requirements and production schedules may require modification if the demand estimate proves to be inaccurate. The planning system must be strong enough to react to unanticipated anticipated errors. Second, a good forecast has more than one number. Given that forecasts are generally false, good forecasts also include some estimates of anticipated error estimates. This can be in the form of a range, or error size such as the variance of the forecast error distribution. Third, *Aggregate forecast* is more accurate. Remember from statistics that the variance of the average set of independently differentiated random variables is lower than the variance of each random variable; That is, the variance of the sample mean is less than the population variance. The same phenomenon also occurs in forecasts. Percentage, errors made in sales forecasting for the overall product line are generally less than the mistakes made in forecasting sales for individual items. Fourth, the longer the approximate horizon, has a smaller accuracy. On this characteristic is quite intuitive. Forecast can estimate the Dow Jones Industrial Average today is more accurate than the value next year. Fifth, Forecast should not be used for information of known data. Certain techniques can produce fairly accurate estimates in most situations. However, there may be information available regarding future requests that were not presented previously. For example, a company might plan sales of a special promotion for a particular item so that its demand may be higher than its normal demand. This information should be taken manually into estimates [2].

### 1.2 Demand Pattern

Demand Pattern within strategic perspectives is deemed indispensable to support prior demand forecast within supply chain management for PT. Promedika Sejahtera (PPS) that requires sustainable industrial systems through Strategic Laboratory Equipment for its stakeholders. There are 4 types of demand patterns in the Time Series Forecasting Method, as illustrated in Figure 1. Each type will be used for demand forecasting with different methods, depending on the existing demand pattern.

Here are 4 types of demand patterns, and they are First, Level or Horizontal Pattern. This pattern has no trend and stationary, the next value will be above average or below average. This pattern can be represented by a stable sale and the number of defects in the production process. Second, Trend Pattern in which Time series shows a stable pattern of growth or decline. Third, Seasonal Pattern refers to Recurrent fluctuation data at fixed intervals. Fourth, Cyclical Pattern in which the mentioned pattern is similar to the seasonal pattern, ie the length and magnitude of the cycle may vary due to business or economic fluctuations [3].
1.3 Exponential Smoothing

Chopra & Meindl stated that the Simple Exponential Smoothing Method is the right choice when the request has no observation of trend or seasonality [4]. This method can react more to the latest changes. The request data is given for a period of 1 to n, which has the following formula:

\[ L_0 = \frac{1}{n} \sum_{i=1}^{n} D_i \]

Therefore, the formula for demand forecast is as follows:

A. Simple Exponential Smoothing

\[ F_t = \alpha \times D_t + (1 - \alpha) \times F_{t-1} \]

B. Exponential Smoothing Double Parameter (Metode Holt’s)

Holt’s method is the right method when demand is assumed to have a level and trend in the systematic component, but it has no seasonality. The "\( \alpha \)" and "\( \beta \)" constants are chosen to be between 0 and 1. Here is the formula by using Holt’s Method:

\[ F_t = S_t + \tau \times G_t \]
\[ S_t = \alpha \times D_t + (1 - \alpha) \times (S_{t-1} + G_{t-1}) \]
\[ G_t = \beta \times (S_t - S_{t-1}) + (1 - \beta) \times G_{t-1} \]

C. Exponential Smoothing Triple Parameter (Metode Winters’)

Winters’ Model method is appropriate when systematic component demand has level, trend, and seasonal factors. Estimates on this procedure are used to estimate future periods using the following formula 5[7]:

\[ F_{tt+t} = (S_t + \tau \times G_t) \times C_{t+t-N} \]
\[ S_t = \alpha \cdot (D_t / C_{t-N} + (1 - \alpha) \times (S_{t-1} + G_{t-1}) \]
1.4 Economic Order Quantity (EOQ)

Economic Order Quantity is an inventory control technique introduced in 1914. The EOQ model itself is an inventory management model used to minimize the total cost of ordering costs and holding costs. Meanwhile, this paper assumes EOQ be several assumptions that is first demand that is known to be fixed and free. Second, the lead time held must be constant between the ordering time of goods and receipt of orders. Third, no discounts apply because quantity is not possible. Fourth, variable cost is only the cost of booking or set up cost and inventory storage cost. Fifth, little inventory can be avoided if done at the right time.

There are conceptual that are developed an ordering order transfer model to determine the optimal number of retailer orders and the number of per order transfers from the warehouse. The EOQ model for ending inventory becomes zero and profit maximization. Therefore, based on the journal of its author scholar work on its e-learning of EOQ [5, 6]. EOQ can be interpreted as to optimize the purchase of goods that can minimize the cost of inventory so that inventory of goods within the company can run well [7, 8].

2. Methods and Research Methodology

The Methods and Research Methodology in this paper can be simplified within the following Figure 2, as adopted within Partial Least Square (PLS), through the Antecedents “Ease”, “Benefit” toward “Acceptance” for stakeholders of strategic laboratory equipment. After correlation and urgency are obtained based on PLS output analysis, the laboratory equipment needs to be classified by using the ABC method. ABC analysis is used in the company to know the type of goods that must be prioritized in advance compared to other goods. It is influenced from the price of goods and the amount of demand for a high product so the company must first order the goods. ABC Analysis Method has the same function with the Pareto Chart is to find out the problems that exist within the company then the company overcome the problem based on the greatest impact to the company.

![Figure 2. Structural of Partial Least Square (PLS) Discussion](image-url)
3. Discussion on ABC Analysis and Forecasting

3.1 ABC Analysis
Research on this company applied ABC Analysis Method with criteria for group A of 20%, group B 30%, and group C is 50%. Based on the research that has been calculated it can be seen the number of goods that must be prioritized first as many as 12 types of goods contained in group A. Type of goods that are prioritized Pampers XL10, Pampers L10, Pampers M10, Clear Housing 10-3 / 4 "Plastic, Wrench & Plastick Bracket, Otto LXL, Otto M18, Clear Housing 10-1 / 2 "Plastic, Wrench & Plastick Bracket, GF 05 - 1016 MM, PK BIG BLUE 20" 3/4 "BLACK CAP, PK STD CLEAR 10" 1 / 4 WHITE CAP, PK STD CLEAR 10 "3/4" BLUE CAP, and CP 01-508 MM.A group A should be prioritized because the goods are goods that are often ordered by other companies and have high value use. that, supervision of goods in Group A is necessary to be strict supervision so that every customer who wants to order the company can meet the request.

3.2 Forecasting
Forecasting is used in this research to know the demand forecast in the coming year so that company can fulfill customer demand. In this study, the calculation of forecasting using Double Exponential Smoothing with alpha and beta parameters. That's because the pattern shape that is owned from sales data two years earlier showed a random trend and did not have a seasonal so do the calculation with Holt's method.

The type of goods in forecasts is determined based on ABC analysis that has been done before. There are 12 types of goods that must be in forecasts based on group A. However, only 8 items will be calculated forecast. The calculation of forecast for each type of goods is done by using Holt's method and given an alpha value of 0.01 and beta of 0.09. From the previous two-year sales data indicates an unstable demand from month to month. However, after the calculation of forecasts using Holt's method obtained a more stable demand for goods and an increasing trend for each product. There is one type of goods that is Clear Housing 10-1 / 2 "Plastic, Wrench & Plastick Bracket which has a downward trend but relatively stable every month.

3.3 Details on ABC Analysis
Table 1 listing the sale of goods in PT Promedika Sejahtera along with price and amount in one month. The following is the calculation of the number of items that should be prioritized using the ABC Analysis Method:

\[
\begin{align*}
A &= 20 \% \times 60 = 12 \quad ; \quad 80 \% \times 5.861.043.000 = 4.688.834.400 \\
B &= 30 \% \times 60 = 18 \quad ; \quad 15 \% \times 5.861.043.000 = 879.156.450 \\
C &= 50 \% \times 60 = 30 \quad ; \quad 5 \% \times 5.861.043.000 = 293.052.150
\end{align*}
\]
### Table 1. List of Item Items Using ABC Analysis Method

| No | Item | Price  | Qty  | Multiplication Results | Cumulative   |
|----|------|--------|------|-------------------------|--------------|
| 1  | Pampers XL10 | 154.100 | 2.200 | 339.020.000 | 339.020.000 |
| 2  | Pampers L10  | 100.500 | 2.500 | 251.250.000 | 590.270.000 |
| 3  | Pampers M10  | 81.100  | 2.500 | 202.750.000 | 793.020.000 |
| 4  | Clear Housing 10-3/4" Plastic, Wrench & Plastick Bracket | 75.000 | 2.558 | 191.850.000 | 984.870.000 |
| 5  | Otto LXL    | 85.200  | 2.000 | 170.400.000 | 1.155.270.000 |
| 6  | Otto M18    | 77.300  | 2.000 | 154.600.000 | 1.309.870.000 |
| 7  | Clear Housing 10-1/2" Plastic, Wrench & Plastick Bracket | 75.000 | 2.052 | 153.900.000 | 1.463.770.000 |
| 8  | GF 05 - 1016 MM | 160.000 | 943  | 150.880.000 | 1.614.650.000 |
| 9  | PK BIG BLUE 20" 3/4" BLACK CAP | 160.000 | 890  | 142.400.000 | 1.757.050.000 |
| 10 | PK STD CLEAR 10"1/4 WHITE CAP | 65.000 | 2.056 | 133.640.000 | 1.890.690.000 |
| 11 | PK STD CLEAR 10" 3/4" BLUE CAP | 65.000 | 2.015 | 130.975.000 | 2.021.665.000 |
| 12 | CP 01-508 MM | 110.000 | 1.179 | 129.690.000 | 2.151.355.000 |
| 13 | Clear Housing 20-1"+ BRASS, Wrench & Metal Bracket | 185.000 | 691  | 127.835.000 | 127.835.000 |
| 14 | CN BIGBLUE 10"3/4 B/CAP TP KNG | 60.000 | 2.060 | 123.600.000 | 251.435.000 |
| 15 | PK STD WHITE 10"1/4" WHITE CAP | 65.000 | 1.896 | 123.240.000 | 374.675.000 |
| 16 | GF 01-508 MM | 75.000 | 1.586 | 118.950.000 | 493.625.000 |
| 17 | Blue Housing 20-3/4" BRASS, Wrench & Plastic Bracket | 85.000 | 1.358 | 115.430.000 | 609.055.000 |
| 18 | CN BIG CLEAR 10 1/2 WHITE CAP | 60.000 | 1.896 | 113.760.000 | 722.815.000 |
| 19 | CN CARBON GAC MODEL 10 F HC | 55.000 | 2.052 | 112.860.000 | 835.675.000 |
| 20 | PK STD CLEAR 10" 1/2" BLUE CAP | 65.000 | 1.680 | 109.200.000 | 944.875.000 |
| 21 | Blue Housing 10-3/4" Plastic, Wrench & Plastic Bracket | 75.000 | 1.441 | 108.075.000 | 1.052.950.000 |
| 22 | CN BIG CLEAR 10 3/4 W/CAP+KNG | 70.000 | 1.528 | 106.960.000 | 1.159.910.000 |
| 23 | PK BIG BLUE 10" 3/4" BLACK CAP | 75.000 | 1.424 | 106.800.000 | 1.266.710.000 |
| No | Item                                                                 | Price   | Qty  | Multiplication Results | Cumulative   |
|----|-----------------------------------------------------------------------|---------|------|------------------------|--------------|
| 24 | 6 Stages RO 800 GPD (2 Membrane & 2 Pump)                             | 3.000.000 | 35   | 105.000.000            | 1.371.710.000|
| 25 | CN BIG BLUE 10"3/4 B/CAP+KN G                                      | 70.000  | 1.470| 102.900.000            | 1.474.610.000|
| 26 | CN BIG BLUE 20"3/4 B/CAP+KN G                                      | 150.000 | 676  | 101.400.000            | 1.576.010.000|
| 27 | HOUSING STANLES 40" ISI 7                                           | 6.500.000 | 15   | 97.500.000             | 1.673.510.000|
| 28 | RO 3 Ways Dispenser – Small                                          | 2.600.000 | 35   | 91.000.000             | 1.764.510.000|
| 29 | HOUSING STANLES 40" ISI 5                                           | 4.500.000 | 20   | 90.000.000             | 1.854.510.000|
| 30 | PK BIG CLEAR 10"3/4" WHITE CAP                                       | 75.000  | 1.186| 88.950.000             | 1.943.460.000|
| 31 | Confiden L10                                                         | 44.300  | 1.986| 87.979.800             | 87.979.800   |
| 32 | Otto LXL4                                                            | 43.100  | 1.980| 85.338.000             | 173.317.800  |
| 33 | Clear Housing 10-3/4" BRASS, Wrench & Plastic Bracket                | 85.000  | 987  | 83.895.000             | 257.212.800  |
| 34 | CP 01-250 MM                                                         | 55.000  | 1.500| 82.500.000             | 339.712.800  |
| 35 | Clear Housing 10-1" BRASS, Wrench & Plastic Bracket                  | 95.000  | 856  | 81.320.000             | 421.032.800  |
| 36 | Confiden M10                                                         | 39.300  | 2.020| 79.386.000             | 500.418.800  |
| 37 | CN CARBON BLOCK CTO 10 F HC                                          | 55.000  | 1.441| 79.255.000             | 579.673.800  |
| 38 | Realcare                                                             | 37.700  | 2.056| 77.511.200             | 657.185.000  |
| 39 | INLINE POST CARBON 1/4"EZ 11"                                       | 50.000  | 1.528| 76.400.000             | 733.585.000  |
| 40 | GF 01-250 MM                                                         | 40.000  | 1.896| 75.840.000             | 809.425.000  |
| 41 | CN WATER PALEF G 01                                                 | 50.000  | 1.470| 73.500.000             | 882.925.000  |
| 42 | CN BIG CLEAR 10"3/4" W/CAP TP K                                     | 60.000  | 1.200| 72.000.000             | 954.925.000  |
| 43 | Underpad                                                             | 75.000  | 894  | 67.050.000             | 1.021.975.000|
| 44 | RO 3 Ways Dispenser - Tower/Tall                                     | 3.200.000 | 20   | 64.000.000             | 1.085.975.000|
| 45 | 6 Stages RO 75 GPD + Cover + UV                                      | 1.550.000 | 40   | 62.000.000             | 1.147.975.000|
| 46 | CN CARBON BLOCK CTO 10 F BD                                          | 30.000  | 2.060| 61.800.000             | 1.209.775.000|
| 47 | CN STICK CONTROL RO DISPENSER                                        | 30.000  | 2.015| 60.450.000             | 1.270.225.000|
| 48 | Blue Housing 10-3/4" BRASS, Wrench & Plastic Bracket                 | 85.000  | 705  | 59.925.000             | 1.330.150.000|
### Table 1. List of Item Items Using ABC Analysis Method (continued)

| No | Item                                           | Price   | Qty  | Multiplication Results | Cumulative     |
|----|------------------------------------------------|---------|------|-------------------------|----------------|
| 49 | Counter Top (Dolphine)                         | 1.400.000 | 42   | 58.800.000              | 1.388.950.000 |
| 50 | Clear Housing 20-3/4" BRASS, Wrench & Metal Bracket | 175.000 | 330  | 57.750.000              | 1.446.700.000 |
| 51 | CN ADAPTOR RO 50 G 01                          | 30.000  | 1.896| 56.880.000              | 1.503.580.000 |
| 52 | CN CARBON POST MODEL 10F BD                    | 30.000  | 1.680| 50.400.000              | 1.553.980.000 |
| 53 | 5 Stages RO 400 GPD + Cover                   | 1.900.000 | 25  | 47.500.000              | 1.601.480.000 |
| 54 | 6 Stages RO 75 GPD + Cover                    | 1.200.000 | 30  | 36.000.000              | 1.637.480.000 |
| 55 | CN CARBON ACTIVE PUTIH 10" GAC                | 13.500  | 2.053| 27.715.500              | 1.665.195.500 |
| 56 | RO Model Cabinet                               | 1.800.000 | 15  | 27.000.000              | 1.692.195.500 |
| 57 | 5 Stages RO 75 GPD + Cover                    | 1.050.000 | 25  | 26.250.000              | 1.718.445.500 |
| 58 | CN CARBON BLOCK 5M-10"                        | 17.500  | 1.500| 26.250.000              | 1.744.695.500 |
| 59 | SPANNER WRENCHES                               | 8.500   | 1.445| 12.282.500              | 1.756.978.000 |
| 60 | CN BIG CLEAR 20"3/4 BLACK CAP                  | 185.000 | 50   | 9.250.000               | 1.766.228.000 |
|    | **Total**                                      |         |      |                         | 5.861.043.000 |

| Group A | Group B | Group C |
|---------|---------|---------|
|         |         |<tablecell>1</tablecell>|<tablecell>1</tablecell>|<tablecell>1</tablecell>|

#### 4. Conclusion

This paper conveys the theoretical perspectives of sustainable industrial systems through Strategic Laboratory Equipment Industry, within scope of PT. Promedika Sejahtera (PPS). PT Promedika Sejahtera is a company engaged in the laboratory equipment industry, that need its strategic touch on its Strategic Laboratory Equipment.

This paper constitutes collaboration with other papers on Economic Order Quantity (EOQ), Re-Order Point (ROP), and Safety Stock (SS), that convolutes Forecasting, ABC Analysis, and Partial Least Square (PLS). Yet, this paper refers to its focus merely on Forecasting, Demand Pattern, Exponential Smoothing and EOQ.

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