

Building Material Inventory Planning Using Always Better Control (ABC) and Economic Order Quantity (EOQ) Analysis Methods

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Abstrak

TB. Langgeng Jaya is a retail business engaged in the sale of construction materials and building tools. TB. Langgeng Jaya has erratic demand historical data. So the problem arises how much inventory is needed. Building materials in TB. Langgeng Jaya is obtained from quite a lot of distributors or suppliers with different lead times for each company. Inefficient management results in problems in product inventory such as out of stock and excess stock of building materials being sold. To overcome this problem, the method used in this research is Always Better Control (ABC) and Economic Order Quantity (EOQ) analysis. The ABC method is used to classify a large number of product types into three groups, namely group A, group B, and group C. In this approach it results that those included in group A are 30 types of products with a monetary value percentage of 77.46%. group B there are 31 types of products with a monetary value of 12.57%, while for group C there are 89 types of products with a monetary value of 9.97%. Group A has a higher cumulative price percentage value than groups B and C which will later become the focus for further processing using the EOQ method. By using the EOQ (Economic Order Quantity) multi-item multi-supplier and single item single-supplier policies, this can reduce the costs incurred from ordering goods from suppliers. The results of the EOQ (Economic Order Quantity) method approach, namely the difference in costs incurred by the average company, are Rp. 1,192,537.

Keywords: ABC Analysis, EOQ, Multi Item, Multi Supplier.

INTRODUCTION

A business or shop will definitely optimize its sales without any items that don't sell well. Starting from the system of supplying building needs, both the volume and timing of resupplying these goods until the building needs products are sold out to consumers. If too many goods are stocked inversely proportional to the number of requests, then the goods will experience additional costs, such as storage costs, maintenance costs, and other costs.

TB. Langgeng Jaya is a retail business engaged in the sale of construction materials and building tools. TB. Langgeng Jaya is located on Jl. Raya Tayu – Puncel Km. 14 Tegalombo Dukuhseti District, Pati Regency. Based on initial observations made by researchers, it turns out that TB. Langgeng Jaya often runs out of stock of certain goods when there is a sudden surge in demand. So that when there are consumers who want to buy these goods, these goods are not available and consumers become disappointed. As a result of this, the company also can not get the maximum profit. In addition to experiencing out of stock, TB. Langgeng Jaya also often experiences excess inventory in the warehouse because there are certain items whose demand has decreased. This resulted in the TB warehouse. Langgeng Jaya becomes full and runs out of space if you want to accommodate other items.

Therefore, TB. Langgeng Jaya requires an appropriate way or method for calculating inventory related to goods from suppliers. Thus, TB. Langgeng Jaya can procure goods at the right time and with the right amount. up to TB. Langgeng Jaya will always be able to meet the demand for goods from consumers and there will be no more excess stock of goods which will hamper the company's activities and will be able to maximize the sales profits that TB earns. Lasting Jaya.

LITERATURE REVIEW

A. Inventory

Inventories are goods stored for future needs. Good inventory for sale or processed into a new product. Inventories in the industrial context, namely there are raw material inventories, semi-finished product inventories, and finished products. Of course, every company has a production system that is different in its operations, some use make to order, make to stock, assembly to order, or engineering to order systems. Each system in handling inventory will also be different. Inventory is an idle resource (ideal resources) waiting for further processing (Indiyanto, 2008).

B. Costs in Inventory

Costs are expenditures or sacrifice values to obtain goods or services that are useful for the future, or have benefits beyond one accounting period (Jannah, 2018). Costs in the inventory of raw materials are classified into several types, namely:

- Cost of purchase (purchase cost)
- Cost of procurement or ordering (order cost / setup cost)
- Storage costs (carrying costs / holding costs)
 - Capital costs
 - Insurance fee
 - Tax costs
 - Cost of moving goods
 - Expiration fee
 - Product damage cost, and also costs for inventory maintenance
- Stock out cost
- Systematic costs

C. ABC analysis

The originator of ABC analysis is Vilfredo Pareto. Pareto divides the goods stored by the company into 3 classifications, namely ABC. This classification is based on the difficulty of setting and the effect of certain items on the company's costs and profitability. The Pareto law states that a group always has the smallest percentage (20%) that is of value or has the greatest impact (80%) (Afianti & Azwir, 2017).

The following is the classification of the ABC class:

- Class A : Represents goods in units ranging from 15–20% of the total goods, but representing 75–80% of the total value of money.
- Class B : Represents goods in units ranging from 20–25% of the total goods, but representing 10–15% of the total value of money.
- Class C : Represents goods in units ranging from 60–65% of the total goods, but representing 5–10% of the total value of money.

The steps in classifying ABC analysis are:

- a) Determine the annual raw material or product usage for each item
- b) Calculates the annual usage value by multiplying the unit cost by the weekly demand
- c) Sort the value of the use of raw materials from highest to lowest
- d) Calculate the percent use of raw materials or products within one year
- e) Classify items in groups A, B, or C based on the cumulative percentage of usage for one year.

D. Economic Order Quantity (EOQ)

EOQ is a simple method for determining economic order sizes. To use the EOQ method there are several elements that must be known in advance, namely the level of demand from period to period, inventory costs, and lead time. The EOQ method in its use is in accordance with the existing case studies, namely: *Single Item Single Supplier*.

This method is used to calculate the EOQ where the case study at hand is having one raw material or one item obtained from one supplier. The formula used to find the EOQ with this case study is using the basic EOQ formula according to (Pujawan & Mahendrawathi, 2017), namely:

$$Q = \sqrt{\frac{2C_b D}{h}} \quad (1)$$

To find the total costs incurred within one year, namely by using the calculation:

$$TC = \left(\frac{D}{Q}\right) C + \left(\frac{Q}{2}\right) h \quad (2)$$

If the two parties have unequal costs, to obtain the optimal Q value, then the economic Q value of the total cost system must be reduced.

$$Q(b, s) = \sqrt{2D(C_s + C_b)/(h_s + h_b)} \quad (3)$$

Notation :

TC : Total Cost (total cost per year)

D : Total material requirement in one year

Q : Quantity for each order
Cb : Ordering fee per year
Hb : Storage costs per year
Cs : Cost for one time order
hs : Storage cost per unit per year

Multi Items Single Supplier

This method is used to calculate the EOQ which is used for case studies that have various items of raw materials or products obtained from one supplier. The steps in completing the EOQ with this case study according to (Apriadi et al., 2018), namely:

1) Determining the Optimal Amount (m^*)

$$m = \sqrt{\frac{\sum_{i=1}^n H_i R_i}{2A}} \quad (4)$$

2) Determining the Volume each message (Q_i)

$$Q = \frac{R_i}{m^*} \quad (5)$$

3) Determining Total Cost (TC)

$$TC = \sum_{i=1}^n P_i R_i + (m^* \times A) + \left(\frac{Q_1 + H_1}{2} + \frac{Q_2 + H_2}{2} \right) \quad (6)$$

Multi Items Multi Suppliers

This method is used to solve problems with case studies that have many items of raw materials or products obtained from many suppliers. The following is the formula for finding the EOQ for the case study according to (Afini et al., 2013), namely:

$$Q_{Rp}^* = \sqrt{\frac{2 \times K \times D R_{pi}}{h}} \quad (7)$$

$$Total\ Cost\ (TC) = \frac{K \times D}{\sum Q_{Rp_i}} + \frac{h}{2} \times (\sum Q_{Rp_i}) \quad (8)$$

RESEARCH METHODS/EXPERIMENTS

The following is a classification of the methods used in this study, namely:

- Research methods

The research method used for this research is using quantitative methods. Where this research is detailed and structured. This quantitative research method focuses on numbers, graphs, tables, and diagrams as the information obtained.

- Method of collecting data

The data used is obtained from direct observations in the field and also comes from a recap of the company's data regarding the procurement of raw materials.

- Methods of data analysis

The data used comes from data owned by the company, interviews with related parties and journals.

- Analysis

The stages of analysis are:

1. Calculation analysis ABC
2. Calculation of EOQ
3. Determination of ROP
4. Determination of safety stock

RESULTS AND DISCUSSION

A. Data Collection

The following is data on products sold for one year in 2020, namely:

Table 1 Product Prices and Demand

No	Product	Price	Demands	Supply	differe nce
1	Semen Tiga Roda	Rp 57.000	7300	7680	380
2	Besi 6	Rp 27.000	3600	6000	2400
3	Besi 8	Rp 50.000	2400	6000	3600
4	Besi 10	Rp 70.000	900	6000	5100
5	Keramik 40x40 Cm	Rp 55.000	600	4800	4200
6	Keramik 50x50 Cm	Rp 65.000	2400	4800	2400
7	Keramik 25x40 Cm	Rp 65.000	2400	4800	2400
8	Keramik 25x25 Cm	Rp 60.000	600	4800	4200
9	Keramik 25x50 Cm	Rp 85.000	2400	4800	2400
10	Granit 60x60 Cm	Rp 110.000	2400	4800	2400
11	Paving Segi Enam	Rp 55.000	600	900	300
12	Paving Bata	Rp 65.000	240	900	660
13	Kricak	Rp 300.000	120	120	0
14	Esbes 1,5 m	Rp 30.000	1200	1200	0
15	Esbes 1,8 m	Rp 45.000	1200	1200	0
16	Esbes 2,10 m	Rp 49.000	1200	1200	0
17	Esbes 2,4 m	Rp 53.000	1200	1200	0
18	Esbes 3 m	Rp 60.000	1200	1200	0
19	Spandex 3 m	Rp 30.000	120	300	180
20	Spandex 4 m	Rp 30.000	120	300	180
21	Spandex 5 m	Rp 30.000	120	300	180
22	Spandex 6 m	Rp 30.000	120	300	180
23	Kanal C	Rp 85.000	600	600	0
24	Reng Baja	Rp 30.000	600	600	0
25	Closet Jongkok	Rp 235.000	120	120	0
26	Closet Duduk Kecil	Rp 900.000	12	20	8
27	Pintu Kamar Mandi Pvc	Rp 225.000	180	240	60
28	Pintu Kamar Mandi Seng	Rp 170.000	60	60	0
29	Toren	Rp 850.000	24	24	0
30	Gamping	Rp 15.000	360	400	40
31	Angkong	Rp 550.000	60	60	0
32	Triplex 3 ml	Rp 60.000	360	360	0
33	Triplex 6 ml	Rp 80.000	120	120	0
34	Triplex 8 ml	Rp 100.000	120	120	0
35	Triplex 10 ml	Rp 110.000	24	120	96
36	Triplex 12 ml	Rp 175.000	24	120	96
37	Triplex 15 ml	Rp 250.000	24	120	96
38	Triplex 18 ml	Rp 275.000	24	120	96
76	Pompa Air Panasonic	Rp 475.000	180	180	0
77	Pompa Air Sanyo	Rp 500.000	180	180	0
78	Kunci Pintu Kecil	Rp 50.000	240	240	0
79	Kunci Pintutanggung	Rp 85.000	240	240	0
80	Kunci Pintu Besar	Rp 120.000	120	120	0
81	Kunci Pintu Pelor	Rp 150.000	120	120	0
82	Engsel 3 Inc	Rp 15.000	360	600	240
83	Engsel 4 Inc	Rp 20.000	360	600	240
84	Grendel 2 Inc	Rp 6.000	360	360	0
85	Grendel 3 Inc	Rp 8.000	360	360	0
86	Grendel 4 Inc	Rp 10.000	360	360	0
87	Grendel 6 Inc	Rp 15.000	120	120	0
88	Grendel 8 Inc	Rp 20.000	120	120	0
89	Grendel 12 Inc	Rp 23.000	120	120	0
90	Grendel 18 Inc	Rp 60.000	120	120	0
91	Bak Cuci Piring Sayap	Rp 150.000	120	144	24
92	Bak Cuci Piring Tanpa Sayap	Rp 130.000	120	144	24
93	Kran Angsa Pvc	Rp 50.000	288	288	0
94	Kran Angsa Stainless	Rp 120.000	288	288	0
95	Kran 0,75 Inc	Rp 16.000	288	288	0
96	Kran 0,5 Inc	Rp 15.000	288	288	0
97	Keni 0,5 Inc	Rp 2.000	600	600	0
98	Keni 0,75 Inc	Rp 3.000	600	600	0
99	Keni 1 Inc	Rp 4.000	600	600	0
100	Keni 1,25 Inc	Rp 5.000	96	120	24
101	Keni 1,5 Inc	Rp 5.000	96	120	24
102	Keni 2 Inc	Rp 7.000	96	120	24
103	Keni 2,5 Inc	Rp 11.000	96	120	24
104	Keni 3 Inc	Rp 15.000	96	120	24
105	Keni 4 Inc	Rp 17.000	96	120	24
106	Keni 6 Inc	Rp 50.000	120	120	0
107	Lem Pralon	Rp 10.000	300	360	60
108	Lem Kayu Dn	Rp 12.000	360	360	0
109	Lem Fox	Rp 8.000	360	360	0
110	Lem Efoksi	Rp 35.000	120	360	240
111	Handle Pintu 4inc	Rp 4.000	240	240	0
112	Handle Pintu 5 Inc	Rp 5.000	240	240	0
113	Handle Pintu 6 Inc	Rp 6.000	240	240	0

Table 1 Product Prices and Demand (continued)

No	Product	Price	Demands	Supply	differe nce	No	Products	Price	Demands	Supply	differe nce
39	Talang 60 Cm	Rp 13.000	600	1200	600	114	Handle Pintu Besar	Rp 50.000	12	36	24
40	Talang 70 Cm	Rp 14.000	600	1200	600	115	Gergaji Kayu	Rp 60.000	180	360	180
41	Talang 80 Cm	Rp 15.000	600	1200	600	116	Gergaji Besi	Rp 16.000	240	240	0
42	Talang 90 Cm	Rp 16.000	600	1200	600	117	Gergaji Serkel 4 Inc	Rp 30.000	72	240	168
43	Talang Seng 90 Cm	Rp 34.000	600	1200	600	118	Gergaji Serkel 6 Inc	Rp 90.000	72	240	168
44	Pralon 0,5 Inc	Rp 16.000	600	1200	600	119	Mesin Planner	Rp 350.000	24	36	12
45	Pralon 0,75 Inc	Rp 22.000	600	1200	600	120	Mesin Gerinda	Rp 300.000	24	36	12
46	Pralon 1 Inc	Rp 26.000	600	1200	600	121	Mesin Bur Kecil	Rp 240.000	24	36	12
47	Pralon 1,25 Inc	Rp 38.000	600	1200	600	122	Mesin Bur Besar	Rp 340.000	24	36	12
48	Pralon 1,5 Inc	Rp 60.000	600	1200	600	123	Mesin Propil	Rp 350.000	24	36	12
49	Pralon 2 Inc	Rp 65.000	600	1200	600	124	Mesin Serkel Besar	Rp 600.000	24	36	12
50	Pralon 2,5 Inc	Rp 55.000	120	600	480	125	Amplas Rol	Rp 15.000	240	240	0
51	Pralon 3 Inc	Rp 65.000	120	600	480	126	Amplas Kertas	Rp 4.000	360	360	0
52	Pralon 4 Inc	Rp 85.000	120	600	480	127	Kuku Macan Ulir	Rp 8.000	240	360	120
53	Cat Tembok 1 Kg	Rp 32.000	240	360	120	128	Kuku Macan Polos	Rp 8.000	240	360	120
54	Cat Tembok 5 Kg	Rp 100.000	240	360	120	129	Loster Bata	Rp 5.000	240	360	120
55	Cat Tembok 25 Kg	Rp 530.000	24	24	0	130	Loster Semen	Rp 10.000	240	360	120
56	Cat Kayu Altex 50 Cc	Rp 8.000	360	480	120	131	Loster Glasblock	Rp 30.000	120	120	0
57	Cat Kayu Altex 200 Cc	Rp 18.000	240	360	120	132	Tatah 0,25 Inc	Rp 20.000	144	144	0
58	Cat Kayu Altex 500 Cc	Rp 38.000	240	360	120	133	Tatah 0,5 Inc	Rp 22.000	144	144	0
59	Cat Kayu Altex 800 Cc	Rp 55.000	240	360	120	134	Tatah 0,75 Inc	Rp 24.000	144	144	0
60	Paku 0,75 Inc	Rp 20.000	240	360	120	135	Tatah 1 Inc	Rp 25.000	144	144	0
61	Paku 1 Inc	Rp 20.000	240	360	120	136	Tatah 1,25 Inc	Rp 30.000	144	144	0
62	Paku 1,25 Inc	Rp 20.000	240	360	120	137	Tatah 1,5 Inc	Rp 35.000	144	144	0
63	Paku 1,5 Inc	Rp 20.000	240	360	120	138	Tang Kecil	Rp 20.000	144	144	0
64	Paku 1,75 Inc	Rp 20.000	240	360	120	139	Tang Besar	Rp 40.000	144	144	0
65	Paku 2 Inc	Rp 20.000	240	360	120	140	Kikir 3 Inc	Rp 15.000	72	144	72
66	Paku 3 Inc	Rp 20.000	240	360	120	141	Kikir 4 Inc	Rp 15.000	72	144	72
67	Paku 4 Inc	Rp 20.000	240	360	120	142	Kunci Lemari 16 Inc	Rp 10.000	96	144	48
68	Paku 5 Inc	Rp 20.000	240	360	120	143	Kunci Lemari 19 Inc	Rp 12.000	96	144	48
69	Paku 6 Inc	Rp 20.000	240	360	120	144	Kunci Lemari 22 Inc	Rp 20.000	96	144	48
70	Baut 0,5 Inc X 4 Inc	Rp 4.000	600	600	0	145	Engsel Lemari 3 Inc	Rp 10.000	96	144	48
71	Baut 0,5 Inc X 5 Inc	Rp 5.000	600	600	0	146	Engsel Lemari 2,5 Inc	Rp 8.000	96	144	48
72	Baut 0,5 Inc X 6 Inc	Rp 5.500	360	360	0	147	Obat Cor	Rp 40.000	144	144	0
73	Baut 0,5 Inc X 8 Inc	Rp 7.000	360	360	0	148	Bendrat	Rp 25.000	360	600	240
74	Baut 0,5 Inc X 10 Inc	Rp 8.000	360	360	0	149	Begel 8 1 2	Rp 17.000	600	1200	600
75	Pompa Air Simitsu	Rp 450.000	180	180	0	150	Begel 8 1 0	Rp 17.000	600	1200	600
							Total Penjualan		63544		

B. ABC analysis

To determine the ABC group, the following is an example of product calculation in the first order, namely there are three-wheeled cement products, namely as follows:

$$\text{Analisis ABC No.1} = \frac{7300 \times \text{Rp.}57.000}{\text{Rp.}3.209.352.000} \times 100\%$$

$$\text{Analisis ABC No.1} = 12,97\%$$

The next step is to calculate the cumulative percentage for each product. From these results, the products belonging to group A are as many as 30 types of products or 20% of all products with an investment value of Rp. 2,485,860,000 or 75% of the total product investment. Products belonging to group B are 31 products or 20% of all products with an investment value of Rp.403,440,000 or 15% of the total product investment. While products belonging to group C are as many as 89 products or 60% of all products with an investment value of IDR 311,652,000 or 10% of the total product investment in TB. Lasting Jaya.

ABC analysis can be displayed in the form of a pareto diagram as follows:

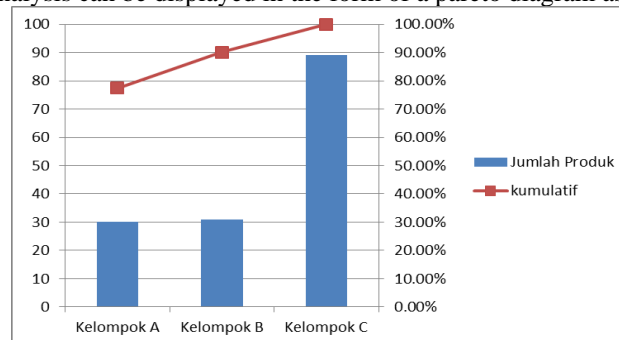


Figure 1 Pareto diagram of the amount of building materials

C. Costs

Costs borne by TB. Langgeng Jaya, which includes ordering costs and storage costs. Here are the details of the costs:

- Order Fee

The costs incurred for the ordering process are IDR 32,000.

- 2. Storage Fees

The storage fee set by the company is 15% of the product price.

D. Economic Order Quantity (EOQ)

Example of calculating EOQ on a product supplied from TB. Langgeng Jaya, namely there are Iron 6, Iron 8 and Iron 10 products which are included in the multi item multi supplier category. If the data is known as in the table below:

Table 2 Required Data for Multi-Item Multi-Supplier EOQ Processing

Product	Demands	Price	Total	D	Cost (K)
Besi 6	3600	Rp 27.000	Rp 79,200,000	245,700,000	32.000
Besi 8	2400	Rp 50.000	Rp 108,000,000		
Besi 10	900	Rp 70.000	Rp 58,500,000		

$$Q_{rp} = \sqrt{\frac{2 \times K \times DR_{pi}}{h}}$$

$$Q_{rp} = \sqrt{\frac{2 \times \text{Rp.}32.000 \times \text{Rp.}245.700.000}{0,15}}$$

$$Q_{rp} = \text{Rp.}10.238.750$$

After calculating the Q_{rp} value, then look for the Q_{rpi} for each product. The total total quantity cost or Q_{rpi} per item of Iron 6, Iron 8, and Iron 10 products is = Rp. .Then look for the Total Cost with the following calculations:

$$\text{Total Cost (TC)} = \frac{K \times D}{\sum QR_{pi}} + \frac{h}{2} \times (\sum QR_{pi})$$

$$\text{Total Cost (TC)} = \frac{\text{Rp. } 32.000 \times \text{Rp. } 245.700.000}{\text{Rp. } 10.238.750} + \frac{0,15}{2} \times \text{Rp. } 10.238.750$$

$$\text{Total cost (TC)} = \text{Rp. } 1.535.812$$

For multi-item multi-supplier products, they are included in class A and some are included in class B and C in the ABC analysis because supplier similarities are then calculated using the Microsoft Excel application. For products that are included in class A in the ABC analysis then calculated using the Microsoft Excel application. To find the optimal quantity in ordering products or raw materials with a single item single supplier case study. For example, to calculate Cement Tiga Roda products supplied from PT. Abadi Dian Perkasa with requests = 7300 items, the initial price or capital (P) = Rp.55,350, the storage fee is 15%, annual demand (D) = Rp.404,055,000.

$$Q = \sqrt{\frac{2CD}{hC}}$$

$$Q = \sqrt{\frac{2 \times 7300 \times \text{Rp. } 32.000}{15\% \times \text{Rp. } 55.350}}$$

$$Q = 248$$

Total Cost (TC)

$$TC = \left(\frac{D}{Q}\right)C + \left(\frac{Q}{2}\right)hC$$

$$TC = \left(\frac{7300}{279}\right) \times \text{Rp. } 32.000 + \left(\frac{248}{2}\right) 15\% \times \text{Rp. } 55.350$$

$$TC = \text{Rp. } 2.056.807$$

Standard Deviation of Lead Time

Calculations for finding safety stock of Iron 6 products, namely, it is known that the shop is open in a year there are 343 days in 2020. Iron 6 products have a normal distribution time with an average of 3 days and a standard deviation of 0.3 days and daily demand for 10 items is obtained of the number of requests in a year, namely 3600 divided by the days the store is open, which is 343 days with a standard deviation of 1.05 items. The service level provided by the company is 95%. So to find the safety stock calculation, you must first calculate the standard deviation during the lead time, namely:

$$sdl = \sqrt{(d^2 \times S_l^2 + 1 \times S_d^2)}$$

$$sdl = \sqrt{(10^2 \times 0,3^2 + 3 \times 1,05^2)}$$

$$sdl = 4,03$$

Safety Stock

$$SS = \text{tabel } Z \times sdl$$

$$SS = 1,645 \times 4,03$$

$$SS = 6,63$$

Reorder Point

For Iron 6 building materials, the time to order the product until the product arrives at the customer is 3 days. Meanwhile, the average consumer demand for Iron 6 products per day is 10.50 items. An example for determining the reorder point for Iron 6 products.

$$ROP = D \times T + SS$$

$$ROP = 10,50 \times 3 + 7$$

$$ROP = 38 \text{ item}$$

CONCLUSION

After taking approaches with these methods, it turns out that they are able to handle stockpiling of inventories and shortages of inventory, and this certainly has an impact on the costs incurred by the company where the costs incurred are relatively less compared to the method used before, the results can improve profit for the

company. The costs incurred previously amounted to Rp. 21,606,218, while the cost of the proposal issued was Rp. 13,778,658. so it has a total cost difference of Rp. 7,827,560.

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