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Optimization Of Raw Material Inventory for Rayon Yarn at Using the EOQ-*Lagrange Multiplier Method* and *Theory Of Constraint*

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Abstract

CV XYZ is a manufacturer of woven sarong in East Java. The problem faced challenges with excess rayon yarn inventory, leading to overcapacity in storage and high costs. Additionally, suppliers' minimum order requirements exacerbate the issue. This study uses the Lagrange Multiplier and Theory of Constraint methods to optimize rayon yarn inventory to minimize costs and storage needs. The results reveal an adjusted storage space requirement of 84 m^3, with details of the total storage space and the minimum order quantity, namely rayon yarn R80/2 of 28.32 m^3 (147 boxes), R60/2 of 25.80 m^3 (134 boxes), and R32/2 of 29.88 m^3 (155 boxes). This method also reduces the total inventory cost to IDR 30,640,592, achieving a remarkable 84.61% saving (IDR 168,574,408) compared to the company's current process. The findings demonstrate that combining Lagrange Multiplier and TOC effectively addresses storage limitations, optimizes order quantities, and minimizes inventory costs.

A. Introduction

Raw material inventory management is one of the crucial aspects of maintaining smooth production. In general, inventory can be defined as materials that can be used in the future to support production and sales activities [1]. Inventory that is not managed correctly can cause serious problems for the company's operations. On the one hand, too much inventory results in high storage costs, the risk of damage to raw materials, and the locking of capital that could otherwise be used for other operational needs [2]. On the other hand, too little inventory can cause a shortage of raw materials, which can disrupt production and cause delays in fulfilling consumer orders. Every company wants to procure the proper inventory so there is no increase in inventory costs [3]. Likewise, CV XYZ, where the company does production with a system made to stock or continuous output.

CV XYZ, a textile company established in 1966, has become an icon of the Indonesian textile industry. CV XYZ is located in Gresik Regency, East Java. With its expertise in producing sarong products using weaving techniques with various modern and innovative motifs, Ketjubung has succeeded in captivating domestic and international markets and is recognized in countries such as Malaysia, Brunei Darussalam, the Middle East, and Africa. This sarong is made manually using ATBM (Non-Machine Weaving Tool) machines. The problem faced by CV XYZ is related to the supply of raw materials for rayon yarn, which is the primary raw material for making woven sarongs. To meet market demand, CV XYZ must provide raw materials of rayon yarn in the storage warehouse so that production can be maintained. The inability to manage raw materials is due to the delivery time of raw materials, which is too fast, namely one week for each supplier. Constraining delivery from suppliers, coupled with limited storage space, also affects the amount of inventory. Other problems that occur are also caused by uncertain market demand fluctuations for sarong products, resulting in overstock or excess raw materials being purchased. Purchasing the same amount of yarn for each type results in a buildup in the warehouse.

Based on data from the company in the form of purchase data and rayon yarn usage data for one year, namely for the R80/2 type, a purchase of 240 boxes was obtained with a usage of 94 boxes or 39.17% of the total yarn purchase with a remaining 146 boxes. Then, the R60/2 type purchased 288 boxes, which accounted for 134 or 46.53% of the total yarn purchase, with the remaining 154 boxes. For the last yarn type 32/2, 480 boxes were purchased using 226 boxes, or 47.08% of the total yarn purchase, with the remaining 254 boxes. The remaining raw materials for rayon yarn were received from as many as 554 boxes.

Based on company data, CV XYZ rayon yarn storage space has a volume of 140 m^3 with a length of 10 m, a width of 7 m, and a height of 2 m. Using cardboard storage media also plays a role in managing warehouse space. The size of the cardboard storage media has a volume of 0.193 m3 with a size of 0.62 m x 0.52 m x 0.65 m, which can accommodate rayon yarn with dimensions of 0.18 m in diameter and 0.28 m in height. Therefore, the rayon yarn storage space can only accommodate 436 boxes, with 106 boxes left over. However, this limitation affects storage efficiency, especially when there is *overstock* at the end of the period. When *over-capacity occurs*, it will affect the storage costs incurred [4]. When storage space is limited, *the raw* material for rayon yarn will be placed outside the raw material warehouse, which will affect the quality of the rayon yarn.

Therefore, optimizing raw material inventory becomes an important aspect that the company must consider [5]. One way of inventory control is to use a combination of the Lagrange multiplier method and the Theory of constraints. The Lagrange method allows companies to find optimal solutions in inventory management by considering certain constraints, such as limited storage capacity [6]. Meanwhile, TOC can be used to maximize raw material orders by considering the capacity of the shipping fleet and the optimal order size from each supplier [7].

The Lagrange multiplier method is used to optimize production costs along with the constraints in the warehouse. This Lagrange multiplier method only refers to one or two constraints [3]. Constraints or problems that are usually solved by the Lagrange Multiplier method deal with overcapacity problems or excess capacity in the warehouse and the increase in inventory costs due to excess capacity. The advantage of using this method is that it allows optimization to be solved without explicit parameters in the constraints. This method is able to handle problems related to warehouse optimization by managing existing raw material inventory by determining the optimal amount of production, thereby minimizing costs [8]. Based on previous research, the Lagrange multiplier method can optimize the amount of raw materials with warehouse capacity constraints [9], [10].

With a combination of the Lagrange multiplier method and the theory of constraints, this research is expected to ensure optimal availability of rayon yarn raw materials so that the production process is not disrupted, limited storage capacity is saved, and minimum total inventory costs are produced. In accordance with the utilization of available fleet capacity, the flow of material from suppliers to storage warehouses can be optimized. The results of this research can help companies make more strategic and wiser decisions regarding inventory management, increase operational efficiency, and minimize the risk of damage to raw materials due to improper storage. This is also expected to positively impact the competitiveness and sustainability of the company's operations in the future.

B. Research Method

This research was conducted in October 2024 until the data was met. The stages of this research are:

1) Identification and Operational Definition of Variables

This research variable uses a Dependent variable with Independent variable.

a. Dependent Variable

The dependent variable is a variable that is influenced by other variables (independent variables). The dependent variable in this research is the optimal supply of raw materials at CV XYZ.

b. Independent Variable

The independent variable is the variable that causes the formation of the dependent variable. In this research, the independent variables are:

1. Requirements for raw material for rayon yarn during Oktober 2023 – September 2024.
2. Ending inventory.
3. Inventory costs.
4. Price of each rayon thread.
5. Warehouse storage capacity.

6. Safety stock.
7. Raw material lead time.
8. Minimum order size.

2) Problem Solving Steps

The problem solving stages of this research are as follows:

a. Field Survey

A field survey is the initial stage of understanding the condition of the company related to the research object to be taken.

b. Literature Study

Literature studies are obtained from literature such as books, journals, and from research that has been carried out previously which is relevant to the problem being researched as a guide for analyzing the object being researched and looking for information about the problem to be solved.

c. Identification of Problems

After making direct observations at the company, existing problems were identified.

d. Method Determination

After the problems in the company are identified, the researcher determines what method is suitable to be used to resolve the problem that will be taken. The method are use combination lagrange multiplier and theory of constraint.

e. Formulation of the Problem

This problem formulation is carried out to find out the essence of the discussion regarding the problem being studied.

f. Research PuIDRoses

The puIDRose of this research is so that research can be directed and have hopes for how this research will be completed. This research aims to produce the optimal amount of ATBM rayon yarn inventory using the Lagrange Multiplier method and Theory of Constraints and to obtain minimum total inventory costs.

g. Variable Identification

Identify variables to find out what variables influence and are related to solving problems using combination the Lagrange Multiplier and theory of constraint method.

h. Data Collection

In the data collection process, researchers collect the data and information needed from the company to solve the problem being studied.

i. Calculation of Warehouse Capacity using the Company Method

Measuring the total available storage space in the warehouse. This is to find out whether there is excess capacity or over capacity in the storage space

j. Total Cost with Company Method (TCp)

Calculating costs using the company's current approach. Calculation of total costs (holding costs and ordering costs) is carried out based on the warehouse capacity of the company method.

k. Inventory Calculation without Constraints Using the EOQ (Q*) Method

Using the Economic Order Quantity (EOQ) formula to determine the optimal order quantity.

l. Calculate the Total New Warehouse Space with EOQ

Calculate total storage or warehouse space based on order size and calculation (Qi*) using EOQ.

m. Calculations with Inventory Capacity Constraints using the Lagrange Multiplier Method (Q_{Li}^*)

Applying the Lagrange Multiplier Method to optimize storage capacity while considering warehouse constraints.

n. Calculation of Total New Storage Space using a combination of the Lagrange Multiplier Method and Theory of Constraint

Combining EOQ results with Lagrange Multiplier optimization.

o. Calculation of Total Inventory Cost using a combination of the Lagrange Multiplier Method and Theory of Constraint (TC Q_{Li}^*)

Calculating optimized total inventory costs using a combination of the Lagrange Multiplier Method and Theory of Constraints.

p. Comparison between The Company Method and The Combination of Lagrange Multiplier and Theory of Constraint Method

If the total inventory cost using the Company Method (TCP) is greater than the total cost using the Lagrange Multiplier Method (TC Q_{Li}^*), the proposed method (Lagrange Multiplier) is accepted. If not, the Company Method remains.

q. Results and Discussion

The results of all calculations obtained will be analyzed and then discussed to find out the final results of solving the problem of conformity to the theory.

r. Conclussion and Suggestion

The final step in this research is to draw conclusions from the calculation results obtained and summarize the findings to determine the optimal way to manage raw material supplies to minimize total costs and provide recommendations or suggestions for subsequent research or the company.

3) Data Collection Method

Data collection methods are divided into two, namely:

a. Primary Data

Primary data is data collected directly by researchers from original sources for specific research puIDRoses. This data is obtained through direct interaction in the field or object being researched. Primary data in this research was obtained through interviews, observation and documentation.

b. Secondary Data

Secondary company data has been collected and published by other parties, either within the company itself or from external sources. To obtain secondary data, data is taken from literature and company documents according to what is needed for the research.

C. Result and Discussion

1) Data Collection

The following is the data collected from the company in one year, from October 2023 to September 2024:

Data on purchasing raw materials for rayon yarn is shown in the Table 1.

Table 1. Yarn Raw Purchase Data (October 2023-September 2024)

Month	Rayon Yarn 80/2 (box)	Rayon Yarn 60/2 (box)	Rayon Yarn 32/2 (box)
October 2023	20	24	40
November 2023	20	24	40
December 2023	20	24	40
January 2024	20	24	40
February 2024	20	24	40
March 2024	20	24	40
April 2024	20	24	40
May 2024	20	24	40
June 2024	20	24	40
July 2024	20	24	40
August 2024	20	24	40
September 2024	20	24	40
Total Purchase	**240**	**288**	**480**
Total		**1008**	

Source : Company Data (2023-2024)

Data on rayon yarn material usage is shown in the Table 2.

Table 2. Rayon Yarn Raw Material Usage Data (October 2023-September 2024)

Month	Rayon Yarn 80/2 (box)	Rayon Yarn 60/2 (box)	Rayon Yarn 32/2 (box)
October 2023	7	9	15
November 2023	7	11	19
December 2023	8	12	20
January 2024	9	13	22
February 2024	7	9	15
March 2024	8	12	20
April 2024	9	13	22
May 2024	7	9	15
June 2024	9	13	22
July 2024	8	12	20
August 2024	9	13	22
September 2024	6	8	14
Total Purchase	**94**	**134**	**226**
Total		**454**	

Source : Company Data (2023-2024)

Final Inventory Data for Rayon Yarn Raw Materials can be seen in Table 3.

Table 3. Final Inventory Data for Rayon Yarn

No.	Yarn Material	Final Inventory (box)	Purchase Cost (IDR)	Final Product Residual Value (IDR)
1	Yarn R80/2	152	IDR 640.000,00	IDR 97,280,000.00
2	Yarn R60/2	162	IDR 925.000,00	IDR 149,850,000.00
3	Yarn R32/2	265	IDR 1.150.000,00	IDR 304,750,000.00
		Total		IDR 551,880,000.00

Source : Company Data (2023-2024)

Inventory Cost can be seen in Table 4.

Table 4. Inventory Cost Data

No.	Type of Fee		Overall Cost	Description
1	Ordering Cost			
	a. Telephone Fee	IDR	150,000.00	Per Month
	b. Administrationfee -ATK - Delivery Note	IDR	100,000.00	Per Month
	c. Labour Cost	IDR	2,500,000.00	Per Month
	Total Biaya Pesan	**IDR**	**2,750,000.00**	**Per Month**
2	Holding Cost			
	a. Raw Material Storage Cost	3%		Per Year
	b. Risk of damage	3%		Per Year
	Total Holding Costs	**6%**		**Per Year**

Source : Company Data (2023-2024)

Unit price for the products can be seen in Table 5.

Table 5. Price of Each Yarn Material

No.	Yarn Material	Purchase Cost (IDR)
1	Yarn R80/2	IDR 640.000,00
2	Yarn R60/2	IDR 925.000,00
3	Yarn R32/2	IDR 1.150.000,00

Source : Company Data (2023-2024)

The warehouse has a function as a temporary place to store raw materials. However, warehouses certainly have limitations to accommodate these raw materials. CV XYZ has a warehouse for storing mindi and mahogany wood with an area of 70 m2 which is 10 meters long and 7 meters wide. The height of the pile of wood arranged according to company regulations is 2 meters. So the volume of warehouse space is 140 m^3. The following is an illustration of the layout of the rayon yarn raw material warehouse at CV XYZ:

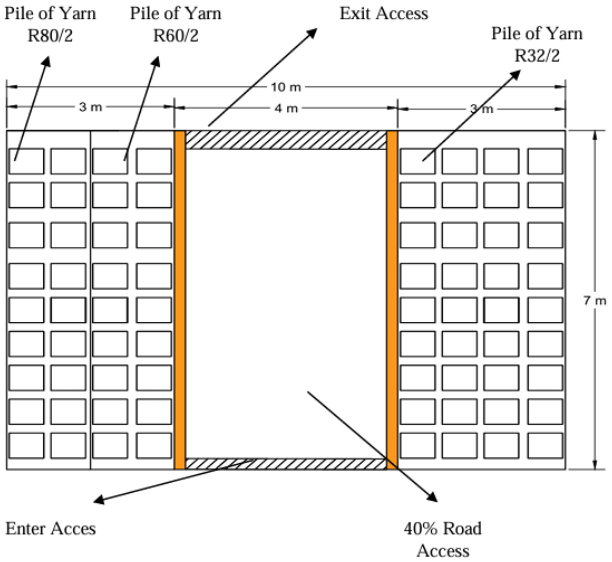

Figure 1. Illustration of the Layout of the Rayon Yarn Raw Material

From the total warehouse volume, 40% will be used as road access for laying yarn, namely by using a forklift and access to the rayon yarn pick-up truck so that the warehouse capacity for raw materials for 3 types of rayon yarn can accommodate as much as:

V_{max} = Warehouse volume total – (40% x Warehouse volume overall) (1)
= 140 m^3 – (40% x 140 m^3)
= 140 m^3 – 56 m^3
= 84 m^3

Table 6. Data on Yarn Material Storage Media, Capacity, and Dimensions

No.	Yarn Material	Product Handling Media	Yarn Capacity per Handling Media (pcs)	Product Storage Dimensions (Wi) (length x width x height) (m^3)
1	Yarn R80/2	Box	12	0,62 x 0,52 x 0,65 = 0,193
2	Yarn R60/2	Box	12	0,62 x 0,52 x 0,65 = 0,193
3	Yarn R32/2	Box	12	0,62 x 0,52 x 0,65 = 0,193
Max Volume Yarn Material Warehouse Capacity				**84 m^3**

Source : Company Data (2023-2024)

Safety Stock of Yarn Material can be seen below.

Table 7. Safety Stock

No.	Yarn Material	Safety Stock (Box)
1	Yarn R80/2	8
2	Yarn R60/2	11
3	Yarn R32/2	18

Source : Company Data (2023-2024)

Lead Time Data can be seen below.

Table 8. Lead Time

No.	Yarn Material	Lead Time
1	Yarn R80/2	2 Weeks
2	Yarn R60/2	2 Weeks
3	Yarn R32/2	2 Weeks

Source : Company Data (2023-2024)

Order Size can be seen below.

Table 8. Lead Time

No.	Yarn Material	Order Size (Box)
1	Yarn R80/2	10
2	Yarn R60/2	12
3	Yarn R32/2	20

Source : Company Data (2023-2024)

2) Data Processing

a. Inventory Control Using Company Methods

Based on warehouse capacity data and order size data, the total warehouse inventory calculation is calculated using the following formula:

Total warehouse storage = $\sum_{i=1}^{n} WiQi \leq W$ (2)

1. Yarn R80/2 = Box dimension x Total Purchase
   = 0,193 x 240
   = 46,32 m^3
2. Yarn R60/2 = Box dimension x Total Purchase
   = 0,193 x 288
   = 55,58 m^3
3. Yarn R32/2 = Box dimension x Total Purchase
   = 0,193 x 480
   = 92,64 m^3

So that total capacity obtained warehouse storage Yarn R80/2, R60/2, and R32/2 are :

46.32 + 55.58 + 92.64 $m^3 \leq$ 84 m^3

194.54 $m^3 \geq$ 84 m^3

Based on the above calculation, the capacity obtained from the method company is 194.54 m^3. Where mark the not optimal because exceeds the existing capacity of CV XYZ, which is 84 m^3.

Calculation of Total Cost Company Method can be seen below.

1. Ordering Cost

Yarn R80/2

Order Frequency = $\left(\frac{\text{Total Yarn R80/2 Need per Year}}{\text{Order Size}}\right)$ (3)
= $\frac{240}{10}$
= 24 kali

Ordering Cost = Order Frequency x Order Cost (4)
= 24 x IDR 2.750.000
= IDR 66.000.000

Yarn R60/2

Order Frequency = $\frac{288}{12}$
= 24 kali

Ordering Cost = 24 x IDR 2.750.000
= IDR 66.000.000

Yarn R32/2

Order Frequency = $\frac{480}{20}$
= 24 kali

Ordering Cost = 24 x IDR 2.750.000
= IDR 66.000.000

Total Ordering Cost = IDR 66.000.000 + IDR 66.000.000 + IDR 66.000.000
= IDR 198.000.000

2. Holding Cost

Yarn R80/2 $= \left(\frac{Q}{2}\right) x$ (α x purchase price) (5)
$= \left(\frac{10}{2}\right) x$ (6% x IDR 640.000)
$= (5) x$ (IDR 38.400)
= IDR 192.000

Yarn R60/2 $= \left(\frac{12}{2}\right) x$ (6% x IDR 925.000)
$= (5) x$ (IDR 55.500)
= IDR 333.000

Yarn R32/2 $= \left(\frac{20}{2}\right) x$ (6% x IDR 1.150.000)
$= (10) x$ (IDR 69.000)
= IDR 690.000

Total *Cost* with Company Method (TC_p) (6)

TC_p = Ordering Cost + Holding Cost
= IDR 198.000.000 + IDR 1.215.000
= IDR 199.215.000

Based on results total *cost* calculation or total cost supplies that include cost Message and costs save with method company obtained results as big as IDR 199.215.000.

b. Inventory Control Using Combination The Lagrange Multiplier and Theory of Constraint Method

The initial step is calculate inventory without taking into account constraints using the EOQ($Qi*$) method using formula:

$$Q^* = \sqrt{\frac{2 \; x \; Di \; x \; Ai}{a \; x \; Ci}} \quad (7)$$

$$Q^*_{(R80/2)} = \sqrt{\frac{2 \; x \; 240 \; x \; 2.750.000}{0{,}06 \; x \; 640.000}} = 185{,}40 \approx 185 \text{ box}$$

$$Q^*_{(R80/2)} = \sqrt{\frac{2 \; x \; 288 \; x \; 2.750.000}{0{,}06 \; x \; 925.000}} = 168{,}93 \approx 169 \text{ box}$$

$$Q^*_{(R80/2)} = \sqrt{\frac{2 \; x \; 480 \; x \; 2.750.000}{0{,}06 \; x \; 1.150.000}} = 195{,}60 \approx 196 \text{ box}$$

Then, the total storage space can be calculated using the Economic Order Quantity (EOQ) (Qi^*) method with the following formula:

Total Storage Space $= \sum_{i=1}^{n} WiQi^* \leq W$ (8)

1. Yarn R80/2 = Box dimension x EOQ (Qi^*)
= 0,193 x 185 box
= 35,78 m^3
2. Yarn R60/2 = 0,193 x 169 box
= 32,60 m^3
3. Yarn R32/2 = 0,193 x 196 box
= 37,75 m^3

So the total new storage space (warehouse) obtained using the EOQ (Qi^*) method is as follows:

35,78 + 32,60 + 37,75 m^3 ≤ 84 m^3
106,14 m^3 ≥ 84 m^3

After calculating the total new storage space, this value is then converted into cardboard with the following calculation:

Q_i^* ≤ Qmax
185 + 169 + 196 ≤ Qmax
550 ≥ 436

Based on the calculations above, the total new storage (warehouse) space is 106.14 m^3, which can accommodate 550 boxes. However, these results are still not optimal because the order placed exceeds the warehouse capacity owned by CV XYZ, namely 84 m^3, which can only accommodate 436 boxes. Therefore, the solution will continue using the Lagrange Multiplier method.

Inventory calculations using the Lagrange Multiplier method can calculate the optimal production volume ($Q_{Li}*$) as follows:

$$Q_{Li}* = \left(\frac{W}{E}\right) x\ Q_i^* \quad (9)$$

1. Yarn R80/2 = $Q_{Li}* = \left(\frac{W}{E}\right) x\ Q_i^*$
$= \left(\frac{84}{106,14}\right) x\ 185 = 146,73 \approx 147$ dus
2. Yarn R60/2 = $Q_{Li}* = \left(\frac{84}{106,14}\right) x\ 169 = 113,69 \approx 134$ dus
3. Yarn R32/2 = $Q_{Li}* = \left(\frac{84}{106,14}\right) x\ 196 = 154,8 \approx 155$ dus

Then the total new inventory warehouse can be calculated with $Q_{Li}*$, with the following formula:

Total Warehouse Storage (E) = $\sum_{i=1}^{n} WiQ_{Li}* \leq W \geq Q_{Minimum}$ (10)

So that total space obtained new storage (warehouse) with use combination method The Lagrange Multiplier ($Q_{Li}*$) is as follows:

$\sum_{i=1}^{n} WiQ_{Li}* \leq W \geq Q_{Minimum\ order}$
28.32 + 25.80 + 29.88 m^3 ≤ 84 m^3 ≥ 16,21 m^3
84 m^3 ≤ 84 m^3 ≥ 16,21 m^3

Based on total space new storage (warehouse) , next done conversion and get amount appropriate cardboard with capacity storage and minimum order size is as following :

$\sum_{i=1}^{n} Q_{Li}* \leq Q_{Maximal} \geq Q_{Minimal\ order}$
$147 + 134 + 155$ dus $\leq 436\ dus \geq 84\ dus$

Based on the above calculation total space obtained new storage (warehouse) with combination method Lagrange Multiplier and Theory of Constraint (TOC) namely as much as 84 m^3 with details R80/2 yarn of 28.32 m^3 equivalent with 147 boxes , R60/2 yarn of 25.80 m^3 , and R32/2 yarn of 29.88 m^3 equivalent with 155 boxes. These results show the optimal value because the order made does not exceed the warehouse capacity owned by CV CYZ, namely 84 m^3 which can accommodate 436 boxes, and is not less than the minimum order quantity from the supplier, which is 16.21 m^3 or the equivalent of 84 boxes, so that there is no excess capacity in the R80/2, R60/2 and R32/2 yarn material warehouse.

c. Calculation of Total Cost Using Combination The Lagrange Multiplier and Theory of Constraint Method

The total cost calculation using a combination of the Lagrange Multiplier method and Theory of Constraints (TC Q_{Li} *) is as follows:

TC Q_{Li} * = Ordering Cost + Holding Cost (11)

$$= \sum_{i=1}^{n} \frac{Ai\ x\ Di}{Q_{Li}^{*}} + \sum_{i=1}^{n} \frac{Q_{Li}^{*}\ x\ Ci\ x\ a}{2}$$

$$= \left(\left(\frac{\text{IDR 2.750.000 x 240}}{147}\right) + \left(\frac{147\ x\ \text{IDR 640.000 x 0.06}}{2}\right) + \left(\frac{\text{IDR 2.750.000 x 280}}{134}\right) + \left(\frac{134\ x\ \text{IDR 925.000 x 0.06}}{2}\right) + \left(\frac{\text{IDR 2.750.000 x 480}}{155}\right) + \left(\frac{155\ x\ \text{IDR 1.150.000 x 0.06}}{2}\right)\right)$$

= (IDR 4.489.795) + (IDR 2.822.400) + (IDR 5.746.268) + (IDR 3.718.500) + (IDR 8.516.129) + (IDR 5.347.500)

= IDR 30.640.592

d. Comparison of Total Inventory Cost

Table 9. Comparison of the Company's Total Inventory Cost Method with a Combination of the Lagrange Multiplier Method and Theory of Constraints

Metode Perusahaan	**Kombinasi Metode *Lagrange Multiplier* dan *Theory of Constraint***
IDR 199.215.000	IDR 30.640.592

e. Recapitulation of company method calculations using a combination of the Lagrange multiplier method and theory of constraints.

Table 1 Recapitulation of Company Method Calculations with a Combination of the Lagrange Multiplier Method and the Theory of Constraints

Comparison	**Company Method**	**Combination of *Lagrange Multiplier* Method and *Theory of Constraint* (October 2023 – September 2024)**
Size order Rayon Yarn R80/2	240 boxes	147 boxes
Size order Rayon Yarn R60/2	288 boxes	134 boxes
Size orderRayon Yarn R32/2	480 boxes	155 boxes
Total Capacity Size Booking Rayon Yarn R80/2	46.32 m^3	28.32 m^3
Total Capacity Size Booking Rayon Yarn R60/2	55.58 m^3	25.80 m^3

Comparison	Company Method	Combination of *Lagrange Multiplier* Method and *Theory of Constraint* (October 2023 – September 2024)
Total Capacity Size Booking Rayon Yarn R32/2	92.64 m^3	29.88 m^3
Cost	IDR199.215.000	IDR. 30,640,592
Savings from Company Method	-	IDR. 168,574,408
Total % Savings	-	84.61%

Source : Data Processing (2024)

So from that , Company must order as big as For rayon thread R80/2 amounting to 147 boxes , rayon thread R60/2 amounting to 134 boxes , And rayon thread R32/2 of 155 boxes . With mark this , the need room No Again exceed capacity warehouse as big as 436 boxes , In addition , the total cost calculation supply use combination method Lagrange Multiplier and Theory of Constraint also show more results efficient . Total cost inventory produced is as big as IDR. 30,640,592, When compared with method company , combination method Lagrange Multiplier and Theory of Constraint are able save cost as big as IDR. 168,574,408 , or equivalent with savings as big as 84.61%.

D. Conclusion

Based on the data analysis of the ATBM (Non-Machine Weaving Tool) rayon yarn requirement period in October 2023 - September 2024 at CV XYZ, the results obtained using the Company's method calculation with a total space requirement of 194.5440 m^3 , which far exceeds the available warehouse capacity of 84 m^3. This causes overcapacity, which has the potential to disrupt storage efficiency. After optimization using a combination of *the Lagrange Multiplier* and *Theory of Constraint methods*, the space requirement was successfully adjusted to 84 m^3. These results are in accordance with the CV XYZ Warehouse's capacity.

Optimization with method combination *lagrange multiplier* and *theory of constraints* generate total cost supply ATBM rayon yarn (Weaving Tool) No Machine amounting to IDR 30,640,592. Cost This show savings amounting to IDR 168,574,408 or 84.61% compared to with the current method This used by the Company. This result show that method combination *lagrange multiplier* and *theory of constraints* more efficient in manage cost inventory at CV XYZ.

E. References

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