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Analysis of PVC-based Product Inventory Control with Economic Production Quantity and Lagrange Multiplier Methods at PT. XYZ

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A B S T R A C T

PT XYZ is a manufacturing company that produces various kinds of products made from PVC (Polyvynil Chloride). Some of the PVC-based products produced by PT XYZ are transparent sheet, colour sheet, and flooring. The problem that exists at PT XYZ is that the company often produces more than the amount of demand which makes the company have to prepare a storage warehouse with a capacity as large as the number of products produced. With this, the storage warehouse experiences overcapaity in controlling the inventory of products produced by the company. And it can be concluded that the problem that occurs at PT XYZ is inventory control and production quantity planning that has not been well planned. Based on the problems that occur at PT XYZ, the most suitable method used to solve these problems is the Lagrange Multiplier method. This research has a purpose to control the inventory of products made from PVC so as to minimize the total cost of product inventory at PT. XYZ. From the research This study found the optimal production amount of 1,332,999 m. Where with the amount of production, the company needs a warehouse area of 9,299.9 m3. The total inventory cost calculated using the Lagrange Multiplier method is IDR 377,073,841,401 while the company's total inventory cost is IDR 402,844,596,680. So that a savings of IDR 25,770,755,279 or 6.40% is obtained.

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1. INTRODUCTION

Inventory is one of the important factors in business activities, both trading and manufacturing companies. In inventory control, it is necessary to have an inventory recording and calculation system, because inventory can affect the company's financial statements. With inventory, the company can fulfill customer requests in a timely manner so that the company can continue to exist in achieving its goals. PT XYZ is a manufacturing company that produces various kinds of products made from PVC (Polyvynil Chloride). The company is located in Candiharjo village, Ngoro District, Mojokerto Regency. Some kinds of PVC-based products produced by PT XYZ are transparent sheet, colour sheet, and flooring. The problem that exists at PT XYZ is that the company often produces more than the amount of demand which makes the company have to prepare a storage warehouse with a capacity as large as the number of products produced. With this, the storage warehouse experiences overcapaity in controlling the inventory of products produced by the company. And it can be concluded that the problem that occurs at PT XYZ is inventory control and production quantity planning that has not been well planned. This is what makes the company have to pay higher inventory costs and if it is continued, the company will lose profit.

Based on the problems that occur at PT XYZ, the appropriate method used to solve these problems is the Lagrange Multiplier method. This method is the most suitable method to use to solve the problem. Because the type of item or object of research is more than one item or multiproduct, namely PVC-based products with product types in the form of transparent sheets, color sheets, and flooring, so inventory control involves many types of items (n>1). Where these items will be stored in the same warehouse with a limited area of storage. This constraint shows the interaction between many different products and can be included in this method. So that companies can optimize finished product inventory with limited storage warehouse capacity constraints to minimize inventory costs. The Lagrange Multiplier method is a method used to optimize production costs by calculating the amount of production and product inventory by considering the capacity of the storage warehouse. By conducting research on determining the optimal amount of production and inventory control of PVC (Polyvynil Chloride) based products using the Lagrange Multiplier method at PT XYZ, it is hoped that the company can carry out optimal production planning by considering the capacity of the product storage warehouse properly so as to minimize the total cost of product inventory. In the end, the company can minimize inventory costs to produce quality products and get maximum profit. Previous relevant research on inventory control with Lagrange Multiplier has been carried out in several companies, for example PT Rama Putra can save inventory costs and prevent overstock by controlling the supply of sausage and nugget products. The novelty of this research is the application of the Lagrange Multiplier method in the production of PVC-based products. The research was conducted to determine the optimal amount of production so that the company does not incur too large inventory costs.

2. LITERATURE REVIEW

Inventory is a model commonly used to solve problems related to controlling raw materials and finished goods in a company's activities. A distinctive feature of the inventory model is that the optimal solution is focused on ensuring inventory at the lowest cost (Ristono, 2012). All types of companies, both companies that produce goods (manufacturing), and companies engaged in services, inventory has an important role in their business operations (Syukron, 2014). Zulfikarijah (2005) argues that inventory can help important functions that will increase the flexibility of company operations. There are several important objectives of inventory, namely as follows: (1) Dual function. The main function of inventory is to separate the production and distribution processes. When the supply or demand for items is irregular, then securing inventory is the best decision. (2) Anticipate inflation. (3) Obtaining discounts on the amount of inventory purchased. (4) Maintain uncertainty. In an inventory system, there is uncertainty in terms of: demand, supply, and lead time. (5) Maintain economical production and purchasing by determining the purchase lot size by considering the lead time. (6) Anticipate changes in demand and supply.

(7) Meet the needs continuously. (8) Eliminate the risk of delays in the arrival of goods or materials needed by the company. (9) Eliminate the risk of failure / damage to the ordered material so that it must be returned. (10) To store seasonally produced materials so that they can be used when these materials are not on the market. (11) Guarantee the smooth production process of the company. (12) Guarantee optimal use of the machine. (13) Provide assurance of the availability of finished products to consumers. (14) Can carry out production as desired without waiting for the impact or risk of sales.

According to Fredy (2014) confirmed that inventory has a main function as a basis for making tactical decisions involving several parts of the management functions, including: (1) Decoupling Function. Inventory function to hold decouple inventory by using separate operational groupings. (2) Economic Size Function. Large quantities of inventory should be carried out in consideration of discounts on the purchase of materials, discounts on quality in the conversion process, and sufficient warehouse capacity. (3) Anticipation Function Inventory of materials whose function is to save must be done if there is a delay in the arrival of material orders from suppliers. According to Gaspersz (2009) states that in general there are several components of inventory: (1) Demand. Is a number of units of goods taken from inventory. (2) Reordering (Replenishment). This reordering is also distinguished by size, pattern and lead time. (3) Limits or Constraints (Contraints). Contraints are the limiting components of the existing inventory system. According to Zulfikarijah (2005) the cost of this inventory in the company is generally divided into four types, namely: (1) Storage costs (holding costs or carrying costs), which consist of costs that vary directly with the quantity of inventory. (2) Procurement costs (procurement costs) are costs associated with the purchase of goods consisting of ordering costs if the goods required come from outside the company. (3) Purchasing costs are costs incurred to purchase goods, the amount depends on the quantity of goods purchased and the price per unit. (4) Production costs. These costs include raw material costs, labor costs, overhead costs. Economic Production Quantity (EPQ) is the development of an inventory model where the procurement of raw materials in the form of certain components is mass-produced and used alone as a sub-component of a finished product by the company. According to Yamit (2005), Economic Production Quantity (EPQ) or optimal production level is a certain amount of production produced by minimizing the total inventory cost consisting of production set-up costs and storage costs.

The assumptions used in developing the single item EPQ model are that the model is developed for single product inventory, the model is developed for work in process and finished goods inventory, there are no shortages, production and demand levels are constant, there are no replacement and repair activities for equipment damage during period T, and raw materials are available when needed for the production process (lead time / waiting time is zero). The purpose of the EPQ model is to minimize Total Cost (TC) or the minimum total inventory cost.

Formula:
Total Cost of Inventory = Production Cost + Preparation Cost + Storage Cost
Annually it can be stated:
Total annual inventory cost = production cost + set-up cost + holding cost
By replacing Q in the total cost formula with Q*, the minimum total cost can be determined based on the following formula:

$$TC^*(Q) = R\ P + \frac{(p-r)H\ Q^*}{p} \quad \text{.....(2.1)}$$

Total economic production quantity of each production cycle:

$$Q^* = \sqrt{\frac{2CRP}{H(p-r)}} \quad \text{.....(2.2)}$$

According to Putra (2017), the multi-item method is the same as the single-item method. For example, a type of product is made on a cycle and uses the same equipment so that the optimum of production operations for each product can be determined. Here is the formula for calculating the total cost of inventory:

$$TC^* = \sum_{i=1}^{m} P_i R_i + \frac{2(n^*)^2 \sum_{i=1}^{m} C_i + \frac{1}{2n} \sum_{i=1}^{m} \frac{(p_i - r_i) R_i H_i}{p_i}}{2n^*}$$

$$= \sum_{i=1}^{m} P_i R_i + \frac{4(n^*)^2 \sum_{i=1}^{m} C_i}{2n^*}$$

.....(2.3)

Total economic production quantity of each production cycle:

$$n^* = \sqrt{\frac{\sum_{i=1}^{m} \frac{(p_i - r_i) R_i H_i}{p_i}}{2 \sum_{i=1}^{m} C_i}}$$

.....(2.4)

According to Lalu (2003) in Sanvier (2018), Lagrange Multiplier is the most important and useful method for calculus-based optimization. It can be used to optimize functions that depend on a number of independent variables and when functional constraints are involved. Thus, it can be applied to various practical situations provided the objective function and constraints can be expressed as continuous and differentiable functions. The Lagrange Multiplier method is a method used to optimize inventory costs along with the constraints in the warehouse. So that the company can overcome the problems and needs of the company in managing its inventory experienced in connection with the finished good inventory owned.

According to Susanto (2018) the economic production size (Q *) for models limited by storage capacity constraints is as follows:

$$QLi^* = \frac{W\, Q_i^*}{\sum_{i=1}^{n} W_i\, Q_i^*} = \left(\frac{W}{E}\right) Qi^* \quad \text{.....(2.5)}$$

With the calculation of the inventory warehouse area:

$$E = \sum_{i=1}^{n} W_i\, Q_{Li}^* \quad \text{.....(2.6)}$$

Thus a new total inventory space equation is obtained,

$$W \geq \sum_{i=1}^{n} W_i\, Q_{Li}^* \quad \text{.....(2.7)}$$

Description:

W = warehouse capacity to store all inventory items.

w = warehouse requirement for each unit of item i.

E = total inventory warehouse area

Q* = optimal production quantity without constraints in units

QLi* = optimal production quantity with constraints in units

Zulfikarijah (2005) assumes that inventory can help with important functions that will increase the flexibility of the company's operations. There are several important goals of inventory. One of them is when the supply or demand for items fluctuates, then securing inventory is the best decision. Based on the research that has been done, when companies get fluctuating demand, increasing inventory is not always the best solution. In field conditions, increasing inventory without planning can lead to additional storage costs, the company also has to increase the capacity of the inventory warehouse which ultimately results in increased total inventory costs and can cause losses for the company. Therefore, it is necessary to plan product inventory control in order to optimize the amount of inventory and inventory warehouse capacity and minimize inventory costs.

3. RESEARCH METHOD

Researchers collect the necessary data and information from the company to solve the problems to be studied. The data needed in solving the problems in this study are product demand data (data on consumer demand for each product such as transparent sheets, color sheets, and flooring in March 2020 - February 2021), data on the amount of production of each product per day, storage warehouse capacity data used to determine warehouse capacity constraints, price data for each product, production cost data, storage cost data, and set-up cost data. The following is an explanation of the problem-solving steps: The earliest step in the research that signifies the research process will begin at the intended company. Furthermore, preparing a literature review which aims to explore information related to the problem under study from literature such as books, journals, and from previously conducted research that is relevant to the problem being studied along with a field survey which aims to observe the company environment and the problems to be solved.

The problem formulation was obtained, namely "How to determine the optimal amount of production and control the inventory of products made from PVC using the Lagrange Multiplier method at PT. XYZ?". The purpose of the research is to calculate the optimal amount of production with the capacity constraints of the PVC-based product inventory

storage warehouse so as to minimize the total cost of product inventory at PT. XYZ.

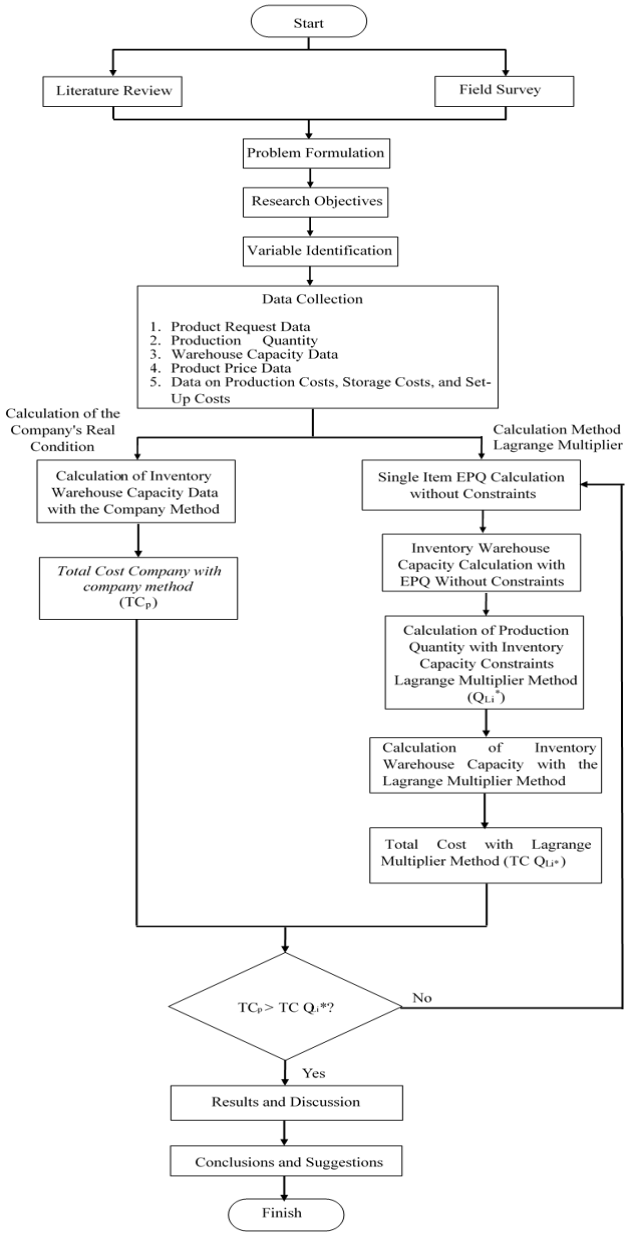

Figure 1. Research stage

Then, identify 2 variables that are influential and related in solving problems with the Lagrange Multiplier method. Researchers collect data that will be used to analyze using the Lagrange Multiplier method. After performing calculations using the proposed method, the results of calculations using the company's method and the Lagrange Multiplier method will be compared in terms of product quantity and total inventory costs. Take analysis of the results of the calculation of production planning and control of transparent sheet, color sheet, and flooring products to find out the final results of solving the problem using the Lagrange Multiplier method. It can be concluded that it is better to carry out production inventory control planning with problem restrictions, namely the data used in the study are product demand data, production quantity data, warehouse capacity data, product price data, production cost data, storage cost data, and set-up cost data and demand and production data for transparant sheet, color sheet, and flooring products taken from the company's historical data for the period March 2020 - February 2021 with storage warehouse capacity constraints so as to minimize total inventory costs.

4. RESULT AND DISCUSSION

4.1 Data Analysis

The data used is obtained through the company's historical data. Such as product demand data, warehouse capacity and inventory costs. After the data has been collected, data processing will then be carried out. Based on the demand for each product, the following is the production demand data for the period March 2020 - February 2021, here is the data for each product

Table 1. Product demand data for March 2020 - February 2021

Period	Transparant Sheet (m)	Colour Sheet (m)	Flooring (m)
March 2020	400.113	672.000	408.657
April 2020	619.456	189.018	376.420
May 2020	275.998	101.983	166.075
June 2020	524.206	334.633	325.224
July 2020	190.076	84.167	139.294
August 2020	791.796	182.500	507.830
September 2020	749.853	281.233	488.008

October 2020	753.020	313.400	234.079
November 2020	792.653	291.424	518.424
December 2020	582.296	461.849	485.749
January 2021	593.740	711.333	618.925
February 2021	889.400	515.533	449.266
Total	**7.162.607**	**4.139.073**	**4.717.951**

(Source : Production data PT. XYZ, 2020-2021)

A. Company Method Inventory Processing

A.1 Company Method Inventory Warehouse Capacity Calculation

Processing of company method inventory control data is done by calculating the total inventory space and then calculating the total cost generated.

Total warehouse inventory = $\sum^{n}_{i}$ =1 W X Q

= Rack Dimensions X $\frac{Production\ per\ Month}{Capacity\ per\ Rack}$

a. Transparant Sheet
= 60 X $\frac{614.524{,}67\ m}{8.600\ m}$
= 4.287,38 m^3

b. Colour Sheet
= 60 X $\frac{376.084{,}42\ m}{8.600\ m}$
= 2.623,84 m^3

c. Flooring
= 60 X $\frac{423.836{,}17\ m}{8.600\ m}$
= 2.956,99 m^3

So the total capacity of the company's inventory warehouse is:

E = $\sum ni$=1 w x Q ≤ W

4.287,38 m3 + 2.623,84 m3 + 2.956,99 m3 ≤ 9.300 m3

9.868,21 m3 ≥ 9.300 m

A.2 Total Cost Company Method

Table 2. Total cost calculation with company method

Product	Total production/ year (Q)	Cost production (P) [Rp]	The lot set ups/year	Cost set up (C) [Rp]	Rate production (p)	Demand annual (R)	Rate demand (r)	Cost save (H) [Rp]
Transparant sheet	7.374.296	18.000	12	2.800.000	20,203.55	7.162.607	19.623,58	2.640
Colour Sheet	4.513.013	20.000	12	3.150.000	12,364.42	4.139.073	11.339,93	3.000
Flooring	5.086.034	35.000	12	3.390.000	13,934.34	4.717.951	12.925,89	4.800

(Source : Production data PT. XYZ, 2020-2021)

Total Cost of the Company (TCp) =
Production Cost + Set Up Cost + Save Cost

TCp = (QxP) + (n *Set Up* x C) + ($\frac{(QxHx(p-r)}{2p}$)

a. Transparant Sheet
=(7.374.296 x 18.000) + (12 x 2.800.000) + ($\frac{(7.374.296\ x\ 2.640\ x\ (20.203{,}55-19.623{,}58)}{2\ x\ 20.203{,}55}$)
= Rp 133.050.357.480

b. Colour Sheet
=(4.513.013 x 20.000) + (12 x 3.150.000) + ($\frac{(4.513.013\ x\ 3.000\ x\ (12.364{,}42-11.399{,}93)}{2\ x\ 12.364{,}42}$)
= Rp. 90.858.970.000

c. Flooring
=(5.086.034 x 35.000) + (12 x 3.390.000) +($\frac{(5.086.034\ x\ 4.800\ x\ (13.934{,}34-12.898{,}50)}{2\ x\ 13.934{,}34}$)

= Rp. 178.935.269.200

Total Cost of the Company (TCp) =
Transparant Sheet + Colour Sheet + Flooring
= Rp. 133.050.357.480 + Rp. 90.858.970.000 + Rp. 178.935.269.200
= Rp. 402.844.596.680

B. Lagrange Multiplier Method Inventory Control

After finding out inventory control using the company method, the next step is to calculate inventory control using the Lagrange Multiplier method. Inventory control with the Lagrange multiplier method begins by calculating inventory without constraints (without constraints), if the results obtained are not optimal then proceed with the calculation of inventory using constraints or constraints.

B.1 Single Item EPQ Calculation without Constraints (Q*)

EPQ (Q*) = $\sqrt{\frac{2\ CRp}{H\ (p-r)}}$

a. EPQ Transparant Sheet

$\sqrt{\frac{2\ x\ 2.800.000\ x\ 7.162.607\ x\ 20.203,55}{2.640\ (20.203,55-19.623,58)}}$=727.509,63 m

b. EPQ Colour Sheet

$\sqrt{\frac{2\ x\ 3.150.000\ x\ 4.139.073\ x\ 12.364,42}{3.000\ (12.364,42-11.339,93)}}$=323.887,00 m

c. EPQ Flooring

$\sqrt{\frac{2\ x\ 3.390.000\ x\ 4.717.951\ x\ 13.934,34}{4.800\ (13.934,34-12.925,89)}}$=303.450,38 m

B.2 EPQ Inventory Warehouse Capacity Calculation Without Constraints

Based on the warehouse capacity data in the table and the calculation of Q* using EPQ, the total new inventory warehouse without constraints can be calculated as follows:

Total storage area (E) =$\sum_{i=1}^{n} Wi$ Q*

= Rack Dimensions X $\frac{EPQ\ (Q^*)}{Capacity\ per\ Rack}$

a. Transparant Sheet

= 60 X $\frac{727.509,63}{8.600}$= 5.076 m^3

b. Colour Sheet

= 60 X $\frac{323.887,00}{8.600}$= 2.260 m^3

c. Flooring

= 60 X $\frac{303.450,38}{8.600}$= 2.117 m^3

So the total capacity of the company's inventory warehouse is:

E = $\sum_{i=1}^{n}$ w x Q ≤ W

5.076 m3 + 2.260 m3 + 2.117 m3

9.452 m^3 > 9.300 m^3

Based on the above calculations, the total result of the new inventory warehouse is 9.452 m3 . This value is still not optimal because the production carried out exceeds the capacity of the storage warehouse at PT XYZ.

B.3 Calculation of Inventory Capacity Constraints Lagrange Multiplier Method (QLi)

After calculating the total warehouse inventory with EPQ, then calculate the production planning with the Lagrange Multiplier method. Based on warehouse capacity data, the results of the calculation of total inventory space without constraints with EPQ, then the calculation of Q Lagrange Multiplier method, the optimal production amount (QLi *) can be calculated as follows:

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

Total Production Lagrange Multiplier (Q_{Li}^{*})

= Q_{Li}^{*} Transparant Sheet + Q_{Li}^{*} Colour sheet + Q_{Li}^{*} Flooring

= $\left(\frac{9.300}{9.452}\right) x$ 727.509,63 + $\left(\frac{9.300}{9.452}\right) x$ 323.887,00 + $\left(\frac{9.300}{9.452}\right) x$ 303.450,38

= 715.778 m + 318.664 m + 298.557 m

= 1.332.999 m

B.4 Calculation of Warehouse Capacity Inventory Lagrange Multiplier Method

Based on the QLi * results above, and warehouse capacity data, the total new inventory warehouse with QLi * can be calculated as follows:

Total storage area = (E) = $\sum_{i=1}^{n} w_I Q^*$

= Rack Dimensions X $\frac{EPQ\ (Q_{Li}*)}{Capacity\ per\ Rack}$

a. Transparant Sheet

= 60 X $\frac{715.778}{8.600}$= 4.993,8 m^3

b. Colour Sheet

= 60 X $\frac{318.664}{8.600}$= 2.223,2 m^3

c. Flooring

= 60 X $\frac{298.557}{8.600}$= 2.082,9 m^3

So that the total capacity of the company's inventory warehouse is :

E = $\sum_{i=1}^{n}$ w x Q ≤ W

4.993,8 m^3 + 2.223,2 m^3 + 2.082,9 m^3

9.299,9 m^3 ≤ 9.300 m^3

Based on the above calculations, the total new inventory warehouse with Lagrange Multiplier is 9.299,9 m3. With a total Lagrange Multiplier production quantity of 1.332.999 m products. This value has reached an optimal condition because the production carried out does not exceed the capacity of the PT XYZ finished product warehouse so that there is no over capacity.

B.5. Total Cost Lagrange Multiplier Method

Table 3. Total cost calculation with lagrange multiplier method

Product	Demand Annual (R)	Cost Production (P) [Rp]	Rate Production (p)	Rate Demand (r)	Cost Save (H) [Rp]	Total Production (Q_{Li}*) [Rp]
Transparant Sheet	7.162.607	18.000	20.203,55	19.623,58	2.640	715.778
Colour Sheet	4.139.073	20.000	12.364,42	11.339,93	3.000	318.664
Flooring	4.717.951	35.000	13.934,34	12.925,89	4.800	298.557

Source: Data analysis

Total cost Metode Lagrange Multiplier

$= (R X P + (\frac{(p-r)HQLi}{p})$

a. Transparant Sheet
=7.162.607xRp 18.000 +
$\frac{(20.203,55-19.623,58)\ x\ 2.640\ x\ 715.778}{20.203,55}$
= Rp. 128.981.171.070

b. Colour Sheet
=4.139.073 x Rp 20.000 +
$\frac{(12.364,42-11.393,93)\ x\ 3.000\ x\ 318.664}{12.364,42}$

= Rp. 82.860.671.822

c. Flooring
=4.717.951 x Rp. 35.000 +
$\frac{(13.934,34 - 12.925,89) \text{ x } 4.800 \text{ x } 298.557}{13.364,42}$
= Rp. 165.231.998.507

Total Cost Metode Lagrange Multiplier (TC Q_{Li}^{*})

= *Transparant Sheet* +*Colour Sheet* + *Flooring*
= Rp128.981.171.070+Rp 82.860.671.822+Rp 165.231.998.507
= Rp. 377.073.841.401

C. Comparison of Total Inventory Cost Results

After calculating the production quantity of the company method and the Lagrange multiplier method, the results of the total product inventory costs obtained can be compared.

Table 3. Comparison of total cost inventory company method with Lagrange Multiplier method

Total Company Inventory Cost	Total Inventory Cost Lagrange Multiplier Method
Rp. 402.844.596.680	Rp. 377.073.841.401

Source: Data Analysis

Savings=$\frac{TC\ Company\ -TC\ Lagrange\ Multiplier}{TC\ Company}$ x 100%

Savings
$= \frac{Rp.\ 402.844.596.680 - Rp.\ 377.073.841.401}{Rp.402.844.596.680}$ x 100%
= 6,40%

From the table above, the company's total cost is IDR 402.844.596.680 and the total cost of the Lagrange Multiplier method is IDR 377.073.841.401 so as to obtain savings of IDR 25.770.755.279 or 6.40%. So it can be concluded that the Lagrange Multiplier method can produce a total cost inventory solution that is more minimal than the company's total cost.

4.2 Results and Discussion

Product inventory control at PT XYZ using the Lagrange Multiplier method obtained the optimal production amount and the amount of product storage area requirements for the period March 2020 - February 2021 for transparent sheet, colour sheet, and flooring products. For the optimal production amount of transparent sheet products, the results are 715,778 m, For the optimal production amount of colour sheet products, the results are 318,664 m, and For the optimal production amount of flooring products, the results are 298,557 m. The total storage area requirement for the three products

is 9,299.9 m^3. This value shows an optimal condition because the amount of production carried out does not exceed the warehouse capacity of PT XYZ which is 9,300 m^3. Production planning is carried out in accordance with the available warehouse capacity so that there is no over capacity of products with the amount of production, namely for transparent sheet products the results are 715,778 m, for colour sheet products the results are 318,664 m, and for flooring products the results are 298,557 m. The results of these calculations resulted in a total used inventory warehouse of 9,299.9 m^3. So that the total available warehouse can accommodate the amount of production calculated using the Lagrange Multiplier method.

In conducting production planning using the Lagrange Multplier method, there are several things that must be added, namely the results of optimal production planning have not fulfilled all company requests. For transparent sheet products, the number of monthly requests is 596,83.92 m with the amount of production from the calculation results with the Lagrange Multiplier method of 715,778 m and from these results transparent sheet products do not experience a shortage of fulfillment of the number of requests. For colour sheet products, the number of monthly requests is 344,922.75 with the amount of production from the calculation results with the Lagrange Multiplier method of 318,664 and the results of the shortage of demand fulfillment are 26,258.75 m with a warehouse area requirement of 183.20 m^3. And for flooring products, the number of monthly requests is 393,162.58 m with the amount of production from the calculation results with the Lagrange Multiplier method of 298,557 m and the results of the shortage of demand fulfillment are 94,605.58 with a warehouse area requirement of 660.04 m^3.

The results of the calculation of the total cost of the Lagrange Multiplier method can minimize the company's inventory costs. The total cost of the new inventory is IDR 377,073,841,401 while the company's total inventory cost is IDR 402,844,596,680. So that a savings of 6.40% or Rp 25,770,755,279 is obtained.Based on the results of previous research conducted at PT Rama Putera with inventory control of sausage and nugget products, the results of the calculation of the total cost of new inventory amounted to Rp. 27,612,704,534 while the company's total inventory cost was Rp. 35,607,319,890. So that a savings of 22.45% or Rp. 7,994,615,360 is obtained. From the results of the research that has been done, both get a total inventory cost that is more optimal than using the company's method so that the use of this method proves to be beneficial to the company by minimizing inventory costs through controlling production planning so as to produce the optimal amount of production and prevent overstock and overcapacity.

5. CONCLUSION

Inventory control of PVC-based products at PT XYZ has produced optimal results by conducting production planning using the Lagrange Multiplier method with warehouse capacity constraints which resulted in a production quantity of 1,332,999 m in the period March 2020 - February 2021 and resulted in a warehouse area of 9,299.9 m^3. These results are said to be optimal because the required warehouse area does not exceed the capacity of the product warehouse at PT XYZ, which is 9,300 m^3. So that the total available warehouse can accommodate the amount of production. After calculating the total cost of the Lagrange Multiplier method, the results show that the calculation using the Lagrange Multiplier method can minimize the company's inventory costs. This is because in each month the amount of production carried out is adjusted to the amount of demand so that there is no overstock and the costs incurred by the company are not too large. From the calculation using the Lagrange Multiplier method, the total cost of the new inventory is Rp. 377,073,841,401 while the company's total inventory cost is Rp. 402,844,596,680. So that a savings of Rp 25,770,755,279 or 6.40% is obtained. For further research, it is recommended that after planning production inventory control, production planning forecasting should be added for the following year period so that the company has careful planning and prevents overstock and overcapacity.

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