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Implementation of Material Requirement Planning (MRP) in Controlling Raw Materials for Shoes Products at PT.XYZ

Chandra Sukma Adhiyasa[1], Indra Dwi Febryanto[2], Prihono[3], Yanatra Budi Pramana[4]
[1234]Industrial Engineering Department, Engineering Faculty, Universitas PGRI Adi Buana Surabaya,

E-mail: indra@unipasby.ac.id

***Abstract*— PT. XYZ is an industry in East Java that produces products made from animal skins as raw materials. The product produced by this industry is loafers. So far, this industry has had problems with leather raw materials which often experience excess supply requiring high investment, although at certain times they also experience shortages which result in not fulfilling consumer demand. MRP is a system specifically designed to ensure the availability of materials, items or components when needed to meet production schedules and ensure the availability of finished products for consumers in situations of surging demand. MRP can answer exactly what material, how much, and when (what, how much and when) is needed so that the production process can run according to schedule. The results of this study indicate that the Material Requirement Planning (MRP) method has a total raw material inventory control cost of Rp. 189,646,600 and by using the company's method, the raw material control value is Rp. 323,325,500 Savings in raw material control costs that can be obtained by applying the MRP method are Rp. 17,416,700 or about 0.94%.**

***Keywords*: Inventory, Material Requirement Planning, Raw Material Control**

I. INTRODUCTION

The industrial world is increasingly advanced along with the development of science and knowledge, which has created intense competition between companies. Companies do various ways to survive and excel. The methods used to increase the company's capabilities, for example, arrangements in the fields of raw materials, production, personnel, and finance, so that an optimal way or method is needed in handling every part of the company.

The production process is the core activity of a manufacturing company. Companies are required to produce quality products to satisfy consumer desires. Therefore, to support production activities, good raw materials must be available and meet production needs effectively and efficiently (Wahyuni&Syaichu, 2015). includes planning what, how, when, and how much of a product is to be produced. Meanwhile, control means control over the production process so that the continuity of the company can continue. One of the planning and control activities within the company is the control of raw materials. (Anggriana, 2015).

Supply is a general term that denotes everything or organizational resources that are stored in anticipation of fulfilling requests (Pandu & Febryanto, 2022). One way that can be done is to control the supply of raw materials to prevent inventory problems from occurring (Rafi &Ngatilah, 2022). Meanwhile, according to (Lahu et al., 2017) raw materials are initial materials or inputs that will be processed to make finished products so that the production process can run smoothly, there is no shortage of inventory (out of stock), and minimal inventory costs are obtained.

Lack of available raw materials will result in the cessation of the production process due to running out of raw materials for production. Currently, the competition in the manufacturing industry is increasing, so a good production

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strategy is needed to win the market. Very tight competition in the business world causes companies to be required to have competitiveness that has more value for consumers. (Kusumahati&Widiasih, 2022).

Silitonga& Moses, (2021) developed a multi-item economic order quantity inventory model by considering expiration factors, all unit discounts, and capacity constraints. The model that has been developed will be tested by making changes to the model parameter values to see its sensitivity. From the results of the sensitivity analysis that has been carried out, it is found that the total cost of inventory is sensitive to the purchase price of a unit of goods. Meanwhile, the ordering time is sensitive to changes in warehouse capacity.

Hikam, (2022) researched how MSME craftsmen control supplies so that MSMEs get the maximum profit. The results showed a savings of 29% with a total inventory cost of Rp. 108,907,812 and safety stock of 30 units.

PT. XYZ is a manufacturing company engaged in the manufacture of shoes. The shoes that are produced are office shoes and various models of shoes for daily needs. PT. XYZ makes shoes based on direct orders from consumers or orders from online websites and online shops that work with companies, so the need for raw materials often fluctuates. Therefore, PT. XYZ needs to plan for the right raw material requirements so that in the procurement of raw material materials an optimal supply is obtained.

MRP (Material Requirement Planning) is a system designed specifically for period demand situations and is independent. MRP is a logical procedure in the form of decision rules and computer-based transaction techniques designed to process a master production schedule into "net requirements" for all items (Utama et al., 2022))
This study aims to plan the raw material requirements for shoes and perform inventory cost calculations so that minimal inventory costs are achieved using the Material Requirement Planning (MRP) method.

II. METHODOLOGY

Material Requirement Planning (MRP) is a technique used for planning and controlling item items (components) that depend on items at a higher level. MRP was first discovered by Joseph Orlicky from J.I Case Company around 1960. The MRP method is a Computer Oriented Approach which consists of a set of procedures, decision rules and a set of recording mechanisms designed to describe a Master Production Schedule (MPS).

Meitriana et al., (2014), MRP has three necessary information inputs, namely Master Production Schedules (MPS) which are used to plan in a phase that determines how much and when the company plans, makes each final product, Product Structure (Bill of Materials (BOM) which is a list of items needed to make or assemble a unit of finished product and Inventory Records File which is a record of inventory items in stock and which have been ordered but not yet received .

The type of research used in this study is a descriptive method with a quantitative approach.

The data used in this study include shoe production data, ordering costs, purchasing costs and storage costs.

Methods of data collection using interviews/interviews and documentation while to analyze the data using the Material Requirement Planning (MRP) method.The MRP steps taken are:

a. Netting
   a calculation process to determine the amount of net requirements, where the value is the difference between the gross requirements and the state of the inventory (those in stock and those being ordered or just waiting for the receiving schedule).
   Formula:
   $Q = \sqrt{\frac{2A}{I,C}}^{0}$
   (1)
   If D_t-I_{t-1}-Q_t> 0
   If $D_t - I_{t-1} - Q_t <= 0$
   Where:
   Rt: Net requirements in a period t
   Dt: Gross requirement in a period t
   I_{t-1} : Inventory at the end of period t – 1
   Q_t : Planned receipt of goods in period t
b. Lotting
   Techniques for determining the optimal order quantity for each item of material or material.
   $E \quad = Q = \sqrt{\frac{2}{C}}^{0}$ (2)
c. Offsetting
   The technique determines when ordering activities are carried out so that efforts to meet net demand levels can be achieved immediately.

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d. Explosion
Calculation of the needs of each item, where the calculation assesses the lower level of the available product structure, and the ordering plan that was previously prepared in the offsetting process.

III. RESULTS AND DISCUSSION

Data collection in this study can be seen in table 1, table 2 and table 3 below:

Table1. Demand for Leather Shoes 2020 – 2021

Period(Month)	Demand(Unit)
June2020	653
July2020	578
August2020	698
September2020	365
October2020	451
November2020	235
December2020	563
January2021	679
February2021	385
March 2021	397
April2021	249
May2021	247
Total	**5.500**

Raw Material Type	Raw Material Prices(Rp)	10% of Raw Material Prices (Rp)
Cow-Hide	37.000	3.700
Outsole	20.000	2.000
Insole	15.000	1.500
Total	72.000	7.200

Table2. Storage Costs Raw Material for Loafer Shoe

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Table 3.Order Cost Raw Materials for Loafers

No.	Raw Material Type	Order Cost
1.	Cow-Hide	Rp.915.000
2.	*Outsole*	Rp.915.000
3.	*Insole*	Rp.32.000

Table4. *Bill Of Materials* (BOM)

Raw Material Type	Quantity	BOM
Leather Shoes	1	Unit
Cow-Hide	4	Feet
Outsole	1	Pair
Insole	1	Pair
Yellow Glue	0,4	Liter
Fox Glue	0,4	Liter
Thread	2	Meters

Table5. Inventory of Loafer Type Shoes Raw Materials

Period	Inventory		
	Cow-Hide(ft)	*Outsole* (pair)	*Insole* (pair)
June2020	528	127	62
July2020	716	179	84
August2020	924	201	106
September2020	1.164	416	121
October2020	1.460	595	170
November2020	1.620	810	205
December2020	1.768	1.017	252
January2021	2.052	1.188	273
February2021	2.312	1.333	318
March2021	2.624	1.556	331
April2021	2.828	1.647	382
May2021	2.940	1.750	415
Total	20.936	10.819	2.719

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Table 6. Master Production Schedule

Month	1	2	3	4
June 2020	41	41	27	27
July 2020	35	87	35	18
August 2020	49	49	33	33
September 2020	58	144	58	29
October 2020	45	45	30	30
November 2020	45	45	30	30
December 2020	18	36	36	89
January 2021	96	39	39	20
February 2021	45	45	30	30
March 2021	42	42	28	28
April 2021	44	44	30	30
May 2021	45	45	30	30

Table 7 Order Frequency and Order Quantity Company method

Period	Cow-Hide		Outsole:Tapak		Insole	
	Freq (x)	Quantity	Freq (x)	Quantity	Freq (x)	Quantity
June 2020	8	2.900	6	720	5	670
July 2020	6	2.500	3	630	3	600
August 2020	10	3.000	7	720	8	720
September 2020	5	1.700	4	580	7	380
October 2020	6	2.100	4	630	5	500
November 2020	4	1.100	5	450	4	270
December 2020	9	2.400	8	770	10	610
January 2021	12	3.000	13	850	11	700
February 2021	4	1.800	3	530	5	430
March 2021	6	1.900	4	620	7	410
April 2021	3	1.200	5	340	2	300
May 2021	4	1.100	3	350	5	280
Total	77	24.700	65	7.190	72	5.870

The calculation results in Table 7 shows that every year the total quantity of orders for cow leather raw materials is 24,700, 7,190 orders for outsole raw materials, and 5,870 orders for insole

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raw materials. From the data obtained it can be seen that the number of orders made when using the company method is very large, this certainly has an impact on increasing the cost of ordering raw materials. The total cost of handling raw materials using the company's method is IDR 323,325,500.

Lot for Lot

The following is the MRP calculation for Lot for Lot (LFL) costs:

$$\text{Saving (\%)} = \frac{\text{The cost system} - \text{The cost system}}{\text{The cost system}} \text{X100\%}$$

$$\text{Saving (\%)} = \frac{11.3.3.5 - 11.1.6.6}{11.3.3.5} \text{X100\%}$$

savings with the Lot for lot (LFL) method = 41%

MRP calculation using the Economic Order Quantity (EOQ) method can be seen in the explanation below:

Economic Order Quantity (EOQ)

$$\text{Saving (\%)} = \frac{\text{The cost system} - \text{The cost system}}{\text{The cost system}} \text{X100\%}$$

$$\text{Saving (\%)} = \frac{11.3.3.5 - 11.1.4.7}{11.3.3.5} \text{X100\%}$$

savings with the Lot for lot (LFL) method =94%

From the steps that have been taken, the following results can be obtained.

Table 8. Comparison of Total Cost of each method

Raw Material	Company Method(IDR)	Lot for Lot(IDR)	*EconomicOrder Quantity*(EOQ)(IDR)
Cow-Hide	192.873.200	125.072.100	13.067.700
Outsole	95.781.000	54.832.000	3.281.000
Insole	34.671.000	9.742.500	1.068.000
Total	323.325.500	189.646.600	17.416.700

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So from the comparison of the two methods above, it can be concluded that the best method to use is the Economic Order Quantity (EOQ) method because the EOQ method calculates the smallest total cost, which is IDR 17,416,700. When compared with the Lot For Lot (LFL) calculation, which is IDR 189,646,600. Because the EOQ method can minimize ordering costs and holding costs so that the total costs incurred are small compared to the LFL method and the Company method.

IV. CONCLUSION

The cost savings that can be obtained by the company after applying the Material Requirement Planning method are Rp. 189,646,600 or around 41% using the Lot for Lot (LFL) method. If you use the Economic Order Quantity (EOQ) method, the savings cost is Rp. 17,416,700 or about 94% of the company's methods that have been applied so far. Companies can determine alternative methods of raw material inventory control techniques, namely the MRP method with LFL and EOQ techniques.

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