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Raw Material Inventory Control in Frozen Street Food SMEs: Applications of JIT and MRP Techniques

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Abstract

Food SMEs still encounter multiple challenges in managing their raw materials, exemplified by ABC Cireng Factory, a small and medium-sized enterprise in the frozen processed street food sector located in Depok City, dealing with issues such as recurring surpluses of tapioca flour raw materials, causing cost inefficiencies and irregularities in order frequencies and quantities monthly. This study aims to assess the inventory management of tapioca flour raw materials at the ABC Cireng Factory by utilizing the company's approach alongside the Just in Time (JIT) and Material Requirement Planning (MRP) methods; to compare all these methods, and ultimately, to suggest a more effective inventory control approach suitable to be implemented. The study reveals that the company's approach results in a total cost of tapioca flour raw material inventory amounting to IDR 11,197,514,500, with an annual raw material purchase of 525,400 kg and an order frequency of 200 times. Using the JIT approach, the overall inventory expense reaches IDR 35,667,065, with a single order size of 1,035 kg and an order frequency of 502 occurrences. In the MRP approach utilizing the Lot for Lot (LFL) method, the overall inventory cost amounts to IDR 10,067,554,320, featuring a total raw material inventory of 474,950 kg annually and an order frequency of 44 times. With the MRP method utilizing the Economic Order Quantity (EOQ) approach, the overall inventory cost amounts to IDR 10,790,524,400 for an order quantity of 50,976 kg and an order frequency of 10 occurrences. The MRP approach utilizing the LFL technique is the most appropriate method for implementation at the ABC Cireng Factory.

Keywords: Tapioca Flour, Cireng, Inventory, Inventory Control, JIT, MRP, EOQ, LFL

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INTRODUCTION

In the evolving landscape of food-based small and medium-sized enteprises (SMEs), raw material inventory control remains a critical determinant of operational efficiency, product quality, and financial viability. Especially within frozen and perishable food sectors, SMEs face multiple challenges: fragile supply chains, fluctuating demand, limited warehouse capacity, and the inherent perishability of ingredients. These pressures often result in either inventory shortages-causing production delays and missed market opportunities-or excessive stockpiles that trigger spoilage and budget excesses.

The ABC Cireng Factory is a small to medium-sized food industry that makes *rujak cireng*, a well-known Indonesian street food snack with a long history. *Cireng* refers to fried aci (*aci digoreng*), a traditional Sundanese dish created by frying a dough primarily composed of tapioca flour. Situated in the Bojongsari District of Depok City, West Java, it has been functioning since 2013. With its existing production levels, Rujak Cireng has accessed multiple markets, extending beyond just Depok City as well as in different cities in Indonesia, including Surabaya, Bandung, Palembang, Medan, and other key cities. The ABC Rujak Cireng product has received halal certification from the Indonesian Ulama Council (MUI) and is recognized as safe by the Food and Drug Supervisory Agency (BPOM). At present, this company is dedicated to creating training initiatives, boosting marketing strategies, and elevating the living conditions of the local community to an improved standard. Via this rujak cireng venture, ABC Cireng Factory employs workers and empowers residents to participate in rujak cireng production.

Compounding the issue, numerous SMEs continue to use manual or partially digital systems, missing the real-time insights and forecasting tools essential for robust inventory planning. In response, two well-known strategies provide strategic options: Material Requirements Planning (MRP) and Just-in-Time (JIT). MRP offers an organised, estimate-based methodology that determines material requirements according to production timelines, whereas JIT focuses on efficient practices, reducing inventory levels by closely matching purchasing with real demand. According to Heizer and Render (2017), MRP is a demand-driven model that uses a list of material requirements, inventory status, estimated receipts, and master production schedules to determine material requirements. MRP can help a business with organizing and streamlining raw material procurement, customized to meet the company's specific production requirements (Kortabarria, et. al., 2018). According to Maiga and Jacob (2008), the application of Just-In-Time can improve assets, productivity, sales growth, company characteristics, and the company's position in the modern business world. The implementation of Just-In-Time

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only requires the units needed to be available in the required quantities and at the required times (Bayo Moriones et al., 2008). This research examines how food SMEs can leverage MRP and JIT strategies-especially with tools such as Economic Order Quantity (EOQ) and Lot-for-Lot (LFL)-o tackle raw material issues and establish more sustainable, cost-efficient inventory management systems.

RESEARCH METHOD

Materials and Methods

The research was conducted at ABC Cireng Factory, located in Bojongsari, Depok, West Java, from December 2024 to March 2025. Primary data was gathered by directly observing the management of raw material inventory at the ABC Cireng Factory, along with semi-structured interviews conducted with the owner and two staff members, specifically the finance manager and the head of production and storage. Simultaneously, secondary information was gathered from internal company records and archives pertinent to the emphasis of this research.

Quantitative research techniques were employed to gather data, which would subsequently be analyzed through calculation methods to ascertain the minimum inventory expense for tapioca flour raw materials at the ABC Cireng Factory. This research exclusively employs the Just in Time (JIT) and Material Requirement Planning (MRP) methods alongside Lot For Lot and Economic Order Quantity (EOQ) techniques, as these approaches align well with the ABC Cireng Factory's traits, utilizing a single raw material and being straightforward to implement within small and medium-sized enteprises (SMEs) that continue to rely on conventional systems and manual documentation. The JIT approach is utilised as a benchmark to evaluate the effect on cost effectiveness when orders are made more often. The MRP technique is utilized to match orders with real demand. Quantitative data analysis was performed with computer software applications, specifically Microsoft Excel and a calculator.

Inventory Costs

The assessment of control over raw materials starts with an evaluation of the tapioca flour inventory cost, encompassing ordering expenses and storage fees. Ordering costs encompass all expenses associated with acquiring tapioca flour raw materials, including administrative fees, costs related to placing orders, supplier selection expenses, shipping charges, loading/unloading operations, and costs for receiving and inspecting

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the raw materials. Costs associated with annual raw material procurement are established utilizing the equation as outlined.

$$Tapioca\ Flour\ Ordering\ Cost = \frac{D}{Q} xS \quad \text{..... (1)}$$

D = Quantity of tapioca flour used per year (kg)
Q = Quantity of tapioca flour per order (kg)
S = Ordering cost of tapioca flour per order (IDR)

In addition to order costs, the inventory costs that need to be known and calculated are storage costs, which are costs incurred in connection with the maintenance of tapioca flour raw material inventory. Storage costs include warehouse administration costs, electricity costs, capital costs embedded in tapioca flour raw material inventory, depreciation costs of goods during storage, and warehouse staff salaries. Annual storage costs for raw materials can be calculated using the formula below:

$$Storage\ Cost = \frac{Q}{2} xH \quad \text{..... (2)}$$

Q = Quantity of tapioca flour per order (kg)
H = Storage cost of tapioca flour per unit per year (IDR)

The total cost incurred by the company to procure raw material inventory of tapioca flour is referred to as the total inventory cost. Total inventory costs for tapioca flour raw materials are obtained by summing the ordering costs and storage costs for raw materials. The total raw material inventory can be calculated using the following formula.

$$TIC = Ordering\ Cost + Storage\ Cost \quad \text{.....(3)}$$

TIC = Total inventory costs for tapioca flour (IDR)

Just In Time (JIT)

In calculations employing the Just In Time (JIT) approach, the necessary data encompasses order specifications and the consumption of tapioca flour raw materials, alongside the expenses incurred during ordering and the storage costs associated with tapioca flour raw materials. The Just In Time (JIT) approach seeks to reduce inventory expenses by ordering more frequently. Prior to establishing the best quantity of tapioca flour orders for the company, it is essential to compute the ideal number of tapioca flour deliveries. To find the ideal quantity of tapioca flour shipments, the formula below is employed:

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$$na = \left(\frac{Q^*}{2a}\right)^2 \quad \text{.....(4)}$$

n = Optimal amount of tapioca flour shipment (kg)
Q*= Economic Order Quantity (EOQ)
a= Average target stock of tapioca flour in units (kg)

Next, to determine the optimal amount of tapioca flour to order, it can be calculated using the equation below:

$$Q_n = \sqrt{na\ x\ Q^*} \quad \text{.....(5)}$$

Qn = Optimal amount of tapioca flour shipment (kg)
Q* = Economic Order Quantity (EOQ)
na = Average target stock of tapioca flour in units (kg)

To calculate the optimal frequency of tapioca flour delivery per order, the following equation can be applied:

$$q = \frac{Q_n}{na} \quad \text{.....(6)}$$

q = Optimal quantity of each shipment (kg)
Qn = Optimal quantity of raw material orders (kg)
na = Optimal number of raw material shipments (kg)

The frequency of raw material orders refers to the total orders for tapioca flour that the ABC Cireng Factory needs to place during each timeframe. To assess the rate of raw material orders through the JIT system, the following equation may be applied.

$$N = \frac{D}{Q_n} \quad \text{.....(7)}$$

N = Frequency of tapioca flour orders in a given period
D = Total annual demand for tapioca flour (kg)
Qn = Quantity of tapioca flour ordered each time (kg)

The overall expense of tapioca flour raw material inventory employing the JIT approach necessitates information derived from the computation of the overall cost of raw material inventory via the company method and the ideal delivery volume of tapioca flour

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raw materials. To ascertain the total cost of raw material inventory in the JIT system, the following equation may be applied.

$$T_{jit} = \frac{CQ_n}{2n} + \frac{OD}{Q_n} \quad \text{.....(8)}$$

T_{jit} = Total cost of tapioca flour inventory (IDR)
C = Storage cost of tapioca flour (IDR)
Q_n = Quantity ordered each time (kg)
O = Cost per order (IDR)
D = Total annual tapioca flour requirement (kg)
n = Optimal delivery quantity (kg)

Material Requirement Planning (MRP)

The MRP method uses a list of material requirements, inventory status, estimated receipts, and master production schedule to determine the optimal and efficient requirements for dependent raw materials. The MRP method is carried out by determining lot sizing using a raw material planning format table in Table 1.

Table 1. Scheduling Format for Planning Tapioca Flour Raw Materials in the MRP Method

No	Description	Period									
1	Gross requirements (kg)	1	2	3	4	5	6	7	8	9	10
2	Recurring payments										
3	Existing stock (kg)										
4	Net demand (kg)										
5	Order receipt plan (kg)										
6	Purchase order plan (kg)										

The Material Requirement Planning (MRP) method is carried out by determining lot sizing using a raw material planning schedule table with the MRP Lot For Lot (LFL) technique and the Economic Order Quantity (EOQ) technique.

1. Lot For Lot (LFL) Technique

The results of using the LFL technique are obtained by examining the tapioca flour demand schedule entered into the MRP method format table, as shown in Table 1. The

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data used in the MRP method format table includes the gross demand for tapioca flour for production and the initial inventory data. The initial inventory is the stock of tapioca flour in the warehouse that is included in the weekly production period. After the data is obtained, if the raw material inventory in the warehouse is still available and sufficient for production needs, the company does not need to place an order for tapioca flour. Raw material orders are placed according to the lead time for tapioca flour orders. The quantity of tapioca flour ordered using the LFL technique is equal to the gross requirement for the next period and is included in the order execution plan for the ordering period. The total orders received match the scheduled order for tapioca flour set for the upcoming period.

2. Economic Order Quantity (EOQ) Method

The outcomes from applying the EOQ method are derived by examining the timeline of raw material needs recorded in the MRP format table, as illustrated in Table 1. The volume of raw material requests is established through the EOQ method, relying on the optimal order quantity derived from the EOQ equation. EOQ calculations are necessary to complete the order plan table for every period. The MRP method table is completed in the same way as the LFL technique once the optimal order quantity is established.

RESULT AND DISCUSSION

The ABC Cireng Factory Raw Material Inventory Control

The ABC Cireng Factory uses tapioca flour as its primary raw material, sourced from supplier PT. Haji Muhammad Ilyas (HMI), with whom it has a partnership based on mutually agreed-upon price and quality standards. If the supplier is unable to provide the required amount of raw materials due to a decline in the quality of tapioca flour during the rainy season, the ABC Cireng Factory will typically reduce its production volume. Raw materials are purchased based on experience, adjusting to the amount used in the previous period. Orders are placed when the inventory in the warehouse is nearly depleted or completely depleted. During the period leading up to Ramadan and Eid al-Fitr, ABC Factory places larger raw material orders as a precaution, which has resulted in excess raw materials in the warehouse and wasteful storage costs. During the rainy season, ABC Cireng Factory reduces production volume to maintain production efficiency and product quality.

The raw material procurement system implemented by ABC Factory begins with production managers (PM) planning production volumes and calculating the amount of raw materials needed for the coming month based on production targets and orders. The steps involved are as follows:

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1) Creating a Production Plan: The PM creates a production plan for one month based on the amount of tapioca flour available in the raw material storage warehouse, adjusted to the remaining products available, and consumer demand for that month
2) Creating an Order Plan: The tapioca flour ordering plan is made by the PM, followed by reporting the amount of raw materials that must be ordered to the finance manager (FM).
3) Placing Orders: The FM places orders after receiving the raw material report from the PM. The FM prepares a purchase budget and places orders with tapioca flour suppliers via the WhatsApp application. Orders are placed 200 times a year, with 16 to 20 orders placed per month, averaging 43,783 kg per order. After the raw materials are ordered, the tapioca flour arrives at the company within one day. Payment is made via non-cash methods.

The tapioca flour raw materials that have arrived at the factory are then stored in the warehouse. Based on an interview with the warehouse manager, the quality inspection of tapioca flour is conducted the following day because the raw materials are received in the afternoon. The quality criteria for tapioca flour in accordance with ABC Factory's SOP are: odorless, pure white in color, smooth texture, and low moisture content. The quality inspection of tapioca flour is conducted by examining the physical form of the tapioca flour and testing the viscosity of the dough by making a dough mixture.

The tapioca flour raw material is stored in a warehouse with a capacity of 20,000 kg and can last up to 6 months. If it exceeds this period, the quality deteriorates, such as the dough becoming less viscous. The usage of tapioca flour raw materials at the ABC Cireng Factory is adjusted to the average monthly production requirement of 53,088 kg. The use of tapioca flour raw materials follows the FIFO (First in First Out) system, where the first batch of tapioca flour stored in the warehouse is the first batch to be released for processing. In general, controlling tapioca flour inventory requires two cost components, namely raw material ordering costs and raw material storage costs.

A. Ordering Costs

Ordering costs are the costs incurred from ordering raw materials from suppliers until the tapioca flour raw materials are available in the storage warehouse. Based on interviews with the FM, ordering costs consist of the purchase cost of tapioca flour at IDR 1,050,000 per 50 kg (per bag) and other costs, including transportation and

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loading/unloading costs, as well as internet costs. Ordering frequency is 200 times during the period July 2023 – June 2024. The following are the components of the factory's purchase and ordering costs for the period July 2023 to June 2024.

1. Raw Material Purchase Costs

It is known that the purchase of raw materials for the period July 2023 to June 2024 amounted to 525,400 kg. The price of tapioca flour raw materials is calculated per bag weighing 50 kg. The price of one bag of tapioca flour weighing 50 kg is IDR 1,050,000. Based on this price, the purchase cost for 525,400 kg of tapioca flour is IDR 11,033,400,000.

2. Transportation Costs

Transportation and loading/unloading costs are incurred by the company every time it purchases tapioca flour. The transportation cost for raw materials is set by the supplier at IDR 400,000 for each delivery.

3. Internet Costs

Based on an interview with the company's FM, the internet cost incurred for a single order is IDR 280.

Table 2. Tapioca Flour Ordering Costs for the Period July 2023–June 2024

No	Type of Cost	Total Ordering Cost (IDR)
1	Raw material purchase cost	11,033,400.000
2	Transportation and loading/unloading cost	80,000,000
3	Internet Cost	56,000
Total Costs		11,113,456,000

Source: Research Data, processed (2025)

The total cost of ordering tapioca flour raw materials for the period July 2023-June 2024 is IDR 11,113,456,000, which is the sum of the purchase cost of raw materials, transportation and loading/unloading costs, and internet costs. To place a single order for tapioca flour with the supplier, the following costs are incurred: transportation and loading/unloading costs to the company's storage warehouse, and internet costs, with a total order cost of IDR 400,280.

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B. Storage Costs

Storage costs are costs incurred over a year to store tapioca flour raw materials, consisting of electricity costs and employee salaries.

1. Electricity Costs

Electricity costs are one component of storage costs for the use of lights as a source of illumination in the raw material storage warehouse, which uses two LED lights with a power consumption of 6 watts each and an average usage time of 9 hours per day. ABC Cireng Factory uses electricity under the R-2/TR category with a power capacity of 3,500 kWh, so the tariff charged is based on the PLN website (web.pln.co.id)isIDR 1,669.53/kWh. The electricity cost required for the two lights in the storage warehouse during the period July 2023 - June 2024 is as follows: Electricity cost = 0.096Wh/day × 365 days × IDR 1,669.53/kWh = IDR 58,500. Therefore, the electricity cost for the lights in the raw material storage warehouse for one year is IDR 58,500.

2. Employee Salaries

ABC Cireng Factory has one warehouse manager and one employee assigned to the tapioca flour raw material storage warehouse. The warehouse manager's salary is set by the company at IDR 4,000,000, and the warehouse employee's salary is at IDR 3,000,000. The total salary cost for workers in the tapioca flour raw material storage warehouse incurred by ABC Cireng Factory for 1 year is IDR 7,000,000.

Table 3. Tapioca Flour Storage Costs for the Period July 2023-June 2024

No	Type of Cost	Total Storage Cost (IDR)
1	Electricity Costs	58,500
2	Employee Salaries	84,000,000
Total Biaya		84,058,500

Storage of tapioca flour for 1 year amounts to IDR 10,829,250. The Cireng factory has plaed an order for 525,400 kg of raw materials for the period July 2023 to June 2024. Therefore, the storage cost for each 1 kg of tapioca flour raw material is as follows:

$$\text{Storage cost per kg} = \frac{IDR\ 84.058.500}{525.400}$$

$$= \text{IDR } 160$$

Therefore, the storage cost for 1 kg of tapioca flour raw material is IDR 160.

Total Inventory Costs

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Total inventory costs are the sum of ordering costs and storage costs incurred by ABC Cireng Factory during the period July 2023 - june 2024. Details of the total costs of tapioca flour inventory can be seen in Table 4.

Table 4. Total costs of tapioca flour inventory

No	Type of Cost	Total Inventory Cost (IDR)
1	Order Cost	11,113,456,000
2	Storage Cost	84,058,500
Total Cost		11,197,514,500

The total inventory costs incurred by ABC Cireng Factory during the period July 2023-June 2024 amounted to IDR 11,197,514,500. Ordering costs are the costs incurred to order 525,400 kg of tapioca flour in 200 orders. Meanwhile, storage costs are the expenses incurred for storing tapioca flour for over one year.

Inventory Control of Tapioca Flour Raw Materials Using Just In Time (JIT) and Material Requirement Planning (MRP)

A. The JIT Approach

The JIT method uses several mathematical formulas in its solution to obtain the following inventory costs.

1. Optimal Delivery Quantity per Order

Determining the optimal order quantity per order requires the order quantity (EOQ) and the average target inventory of tapioca flour raw materials per year. The calculation of the optimal order quantity (EOQ) is provided in Appendix 1. The optimal order quantity per order is determined using the following formula:

$$na = \left(\frac{50.976}{2x5.546}\right)^2$$

= 21,1 rounded to 21

Therefore, the optimal number of deliveries at the ABC Cireng Factory for each order using the JIT method is 21 deliveries.

2. Optimal Order Quantity

The optimal order quantity is the optimal amount of raw materials ordered using the JIT method, determined using the optimal number of deliveries per order and the EOQ.

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The optimal order quantity of tapioca flour raw materials at ABC Cireng Factory using the JIT method is as follows:

$$Qn = \sqrt{21x50{,}976}$$

= 1,034.6 rounded to 1,035 kg

Therefore, the optimal order quantity of tapioca flour raw materials at ABC Cireng Factory for each order is 1,035 kg.

3. Optimal Delivery Quantity per Delivery

The optimal delivery quantity per delivery refers to the optimal amount of tapioca flour raw materials to be delivered in each delivery cycle. This optimal value is calculated by dividing the optimal order quantity based on the JIT method by the delivery frequency for each tapioca flour order.

$$q = \frac{1.035}{21}$$

= 49.3 rounded to 49 kg

Therefore, the optimal delivery quantity of tapioca flour raw materials per delivery is 49 kg.

4. Order Frequency

Order frequency reflects how often the Cireng Brecxelle Factory carries out tapioca flour raw material procurement activities using the JIT method. This frequency is obtained by dividing the total raw material requirement by the optimal order quantity that has been determined.

$$N = \frac{519.350}{1.035}$$

= 501.7 rounded to 502 times

Thus, the frequency of raw material orders for tapioca flour in a year using the JIT method is 502 orders.

5. Total Inventory Costs

The total expenditure of the ABC Cireng Factory to maintain the availability of tapioca flour raw materials is referred to as the total inventory cost. The JIT method is implemented to optimise the total inventory cost in ordering raw materials. The details of the total cost calculation using JIT are as follows:

$$T_{JIT} = \frac{1}{\sqrt{21}} x\ Rp.164.114.500$$

= IDR35,667,065

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Therefore, the total cost of tapioca flour raw material inventory at the ABC Cireng Factory using the JIT method is IDR 35,667,065.

Based on the JIT method calculations, the total inventory cost incurred by the ABC Cireng Factory amounts to IDR 35,667,065 with an order frequency of 1,628 orders per year. The optimal order quantity for tapioca flour raw materials is 1,035 kg. The total inventory cost of raw materials using the JIT method is lower than the total inventory cost using the company's method. However, the order frequency of the JIT method is higher, at 502 times, compared to the company's method, which only places 200 orders per year. This condition is caused by adjusting the frequency of raw material orders based on actual production needs and demand, thereby eliminating activities that could potentially increase inventory costs. This statement aligns with Assauri (2016:295), where the JIT method aims to eliminate factors that could disrupt the production process, enhance flexibility, and reduce waste in inventory.

B. The MRP Approach

1. Material Requirement Planning (MRP) Method with Lot For Lot (LFL) Technique

The MRP method using the Lot for Lot (LFL) technique aims to optimise the storage costs of tapioca flour raw materials at the ABC Cireng Factory to zero. In this technique, tapioca flour raw materials are ordered according to the raw material requirements for a specific period, so that no raw materials are stored or wasted. The LFL technique will produce the amount of tapioca flour ordered according to production requirements. The calculation of the MRP LFL technique is provided below.

D = Annual consumption of tapioca flour raw material is 519,350 kg

S = Ordering cost per order of tapioca flour raw material is IDR 400,280

H = Storage cost per kg of tapioca flour raw material is IDR 160

$$EOQ = \sqrt{\frac{2x519{,}350x400{,}280}{160}}$$

= 50,976.14 or rounded to 50,976

Therefore, the EOQ for tapioca flour raw material at ABC Cireng Factory is 50,976 kg.

Table 5. Frequency of Ordering and Purchasing Tapioca Flour Raw Materials Using the MRP Method and LFL Technique

Month	Frequency of Ordering	Tapioca Flour Purchasing
July 2023	1	4,175

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August 2023	4	45,875
September 2023	4	41,263
October 2023	4	39,463
November 2023	4	44,100
December 2023	4	47,113
January 2024	4	40,913
February 2024	4	44,513
March 2024	4	55,913
April 2024	4	38,000
May 2024	4	44,675
June 2024	3	28,950
Total	44	474,950
Average	3,7	39,579

The frequency of tapioca flour raw material orders at the ABC Cireng Factory using the LFL MRP method was 44 times, with an average of 4 orders per month. The quantity of tapioca flour raw material orders varied each month to meet weekly demand. The total purchase of tapioca flour raw materials during the period July 2023–June 2024 using the LFL technique amounted to 474,950 kg, with an average order quantity of 39,579 kg per month. The quantity of raw material orders using the MRP LFL technique is lower than the quantity of orders using the company's method. This finding aligns with the statement by Kumar and Suresh (2008:120) that the MRP LFL technique reduces inventory by determining the required quantity of raw materials when aligned with demand to meet production schedules. The following is the total cost of tapioca flour raw material inventory at ABC Cireng Factory using the MRP LFL technique.

Table 6. Total Cost of Tapioca Flour Raw Material Inventory MRP Method LFL Technique

No	Type of Cost	Amount
1	Order Frequency (kali)	44
2	Order Cost (IDR)	17,612,320
3	Purchase Cost (IDR)	9,973,950,000
4	Storage Cost (IDR)	75,992,000
Total Inventory cost (IDR)		10,067,554,320

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The total cost of tapioca flour raw material inventory incurred by ABC Cireng Factory during the period July 2023-June 2024 using the MRP LFL technique was IDR 10,067,554,320. The total inventory cost consisted of raw material ordering costs 44 times. The ordering cost amounts to IDR 17,612,320, the purchase cost for 474,950 kg at a price of IDR21,000/kg amounts to IDR 9,973,950,000, and the storage cost for 474,950 kg of raw materials amounts to IDR 75,992,000. The total cost of tapioca flour raw material inventory using the LFL technique is lower than the total inventory cost incurred by the company. It is because the quantity and frequency of raw material orders using the MRP LFL technique are smaller, namely 474,950 kg with 44 orders per year, compared to the company's method, which orders 525,400 kg with 200 orders per year. The lower order quantity and fewer order frequency result in reduced raw material ordering costs, leading to an efficient total raw material inventory cost.

2. Material Requirements Planning (MRP) Method with the Economic Order Quantity (EOQ) Technique

The MRP method with the EOQ technique is a method in which raw material ordering activities are only carried out when inventory levels are insufficient to meet production demand. In this system, the order lot size is fixed and is determined by calculating the storage costs and ordering costs (Anggriana, 2015:324). The quantity of raw materials ordered is constant and does not depend on current demand. Based on the EOQ calculation results listed in Appendix 2, the optimal figure for the order quantity of tapioca flour is 50,976 kg per order. This EOQ value is then filled into the MRP format to determine the quantity and frequency of tapioca flour orders during the period July 2023–June 2024. The MRP calculation using the EOQ technique for tapioca flour raw materials.

Table 7. Frequency of Tapioca Flour Orders and Purchases using MRP Method EOQ Technique

Month	Frequency of order	Tapioca Flour Purchasing
July 2023	1	50,976
August 2023	0	0
September 2023	1	50,976
October 2023	1	50,976
November 2023	1	50,976
December 2023	1	50,976

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January 2024	1	50,976
February 2024	1	50,976
March 2024	1	50,976
April 2024	0	0
May 2024	1	50,976
June 2024	1	50,976
Total	10	509,760
Average	1,5	42,480

The frequency of tapioca flour orders at the ABC Cireng Factory for the period July 2023-June 2024, using the EOQ MRP method, was 10 times, with an average of 1 order per month. No tapioca flour orders were placed in August and April because the tapioca flour raw materials were still available in the storage warehouse. The total purchase of tapioca flour raw materials for the period July 2023 to June 2024 using the EOQ MRP method was 509,760 kg, with an average order of 42,480 kg per month. The quantity of tapioca flour raw material ordered each time is constant for each month, calculated using the EOQ method, which is 50,976 kg. This order quantity is the optimal amount for the company as it aligns with the raw material requirements for each period. The following is the total inventory cost of tapioca flour raw materials at the ABC Cireng Factory using the MRP method with the EOQ technique. The calculation of the total inventory cost of tapioca flour raw materials using the EOQ technique is provided in Appendix 4.

Table 8. Total Cost of Tapioca Flour Raw Material Inventory MRP Method EOQ Technique

No	Type of Cost	Amount
1	Order frequency	10
2	Order cost	4,002,800
3	Purchase cost	10,704,960,000
4	Storage cost	81,561,600
Total Inventory cost		10,790,524,400

The total cost of tapioca flour raw material inventory at ABC Cireng Factory for the period July 2023-June 2024 using the MRP method with the EOQ technique is IDR 10,790,524,400. This total inventory cost is derived from the ordering cost for five orders,

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amounting to IDR4,002,800, the purchase cost of 509,760 kg of tapioca flour at a price of IDR21,000/kg, amounting to IDR 10,704,960,000, and the storage cost for 509,760 kg of tapioca flour, amounting to IDR 81,561,600. The total inventory cost for tapioca flour using the EOQ technique is lower than the company's method, where the total inventory cost using the company's method is IDR 11,197,514,500, while the total cost using the EOQ technique is only IDR 10,790,524,400. The ordering frequency for tapioca flour raw materials using the EOQ technique is significantly lower than the company's method, with 10 orders compared to 200 orders per year using the company's method. The lower total inventory cost using the EOQ technique is due to the smaller quantity and frequency of raw material orders for tapioca flour using the EOQ technique compared to the company's method, thereby reducing expenses for ordering costs.

3. Comparison and Recommendations for Inventory Control Methods of Tapioca Flour for ABC Cireng Factory

The calculation of the total cost of tapioca flour raw material inventory at the ABC Cireng Factory for the period July 2023-June 2024 has been analyzed using the Just in Time (JIT) method, the MRP Lot For Lot (LFL) technique, and the Economic Order Quantity (EOQ) technique. A comparison of the results of the company's inventory control methods was conducted to determine the most suitable and efficient inventory control method to be implemented at the ABC Cireng Factory. The comparison of total inventory costs for tapioca flour using the company's method and the JIT method is presented in Table 9

Table 9. Comparison of Total Costs Between the Company Method and JIT

Description	Company Method	Just In Time Method
Frequency (times)/year	200	502
Ordering cost (IDR)/year	80,056,000	
Storage Cost (IDR)/year	84,058,500	
Total Inventory Cost (IDR)	164,114,500	35,667,065

Based on Table 9, purchase costs in the JIT method are not calculated because the quantity of tapioca flour raw materials ordered remains constant. The JIT inventory control method results in lower total inventory costs compared to the company's method, which is IDR 35,667,065, while the company's method is IDR 164,114,500. The results of this

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study align with the research by Hasibuan et al. (2024) and Khadijah et al. (2023), where in both studies the JIT method was able to produce lower cost calculations compared to the company's method. In this study, the JIT method was able to reduce storage costs because the JIT method does not store inventory, placing small orders of 1,035 kg and with a high delivery frequency of 502 times per year. However, in practice, the company would struggle to handle 502 deliveries per year, which means more than one delivery per day, while the delivery lead time is one day. This situation increases transportation costs, and not all suppliers are willing to ship small quantities regularly, making the JIT method difficult to implement at the ABC Cireng Factory.

This study also calculates the inventory costs of tapioca flour raw materials at the ABC Cireng Factory using the MRP LFL technique and EOQ. The cost calculations using the MRP LFL technique and EOQ were compared with the cost calculations using the company's method to determine the inventory control method that can minimise inventory costs and avoid overstocking. The following is a comparison of the total inventory costs of tapioca flour raw materials using the company's method and the MRP method in Table 10.

Table 10. Comparison of Total Inventory Costs Using the Company Method and the MRP Method

Description	Company Method	MRP Method	
		LFL	**EOQ**
Frequency (times)/year	200	44	10
Quantity (kg)/year	525,400	474,950	509,760
Quantity (kg)/year	80,056,000	17,612,320	4,002,800
Purchase Cost (IDR)	11,033,400,000	9,973,950,000	10,704,960,000
Storage Cost (IDR)	84,058,500	75,992,000	81,561,600
Total Inventory Costs	**11,197,514,500**	**10,067,554,320**	**10,790,524,400**

Based on Table 10, it is known that the MRP method using the LFL technique produces the most efficient total raw material inventory cost of IDR 10,067,554,320 with a total raw material inventory of 474,950 kg and a raw material ordering frequency of 44 orders. The MRP method using the LFL technique results in ordering costs of IDR17,612,320 and storage costs of IDR 75,992,000. The LFL method reduces ordering costs by 78% and storage costs by 9.6% compared to the company's standard method.

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The use of the LFL technique in the MRP method saves raw material inventory costs by 10.09% or IDR 1,129,960,180. The LFL technique in the MRP method has the most efficient storage costs compared to the company's method and the EOQ technique in the MRP method. It is because the LFL technique places orders according to production needs, so the company does not overstock inventory, which can affect storage cost efficiency.

The EOQ technique results in higher total inventory costs than the LFL technique, amounting to IDR 10,790,524,400 with a total inventory of 509,760 kg per year and an ordering frequency of 10 orders per year. The use of the EOQ technique in the MRP method can save a total of 3.63% in inventory costs, or IDR 406,990,100. The EOQ technique of the MRP method optimises tapioca flour orders to 50,976 kg per order with a frequency of 10 orders per year, which can save a total of IDR 76,053,200 in raw material inventory costs, or 95% compared to the company's method. The results of this study align with the findings of Renny and Safitri (2023), where the EOQ method can achieve greater cost efficiency compared to the company's method. However, the optimal order quantity of 50,976 kg is not suitable because the storage warehouse at the ABC Cireng Factory can only accommodate 20,000 kg of raw materials, meaning that the order quantity per order exceeds the warehouse capacity.

The MRP LFL technique is recommended for the ABC Cireng Factory because it has proven to produce efficient order quantities and frequencies, without excess inventory, at a lower total cost than the actual method, and is realistic to implement in the ABC Factory's operational system. This condition aligns with Heizer and Render's (2016:106) statement that the Lot for Lot (LFL) MRP method results in more efficient costs, where the order quantity matches the net requirement quantity, making orders economically and technically timely. Reducing the order frequency by 44 times per year can be done without disrupting. The production process provided that the ABC Cireng Factory can adjust several key aspects, such as:

1. The ABC Cireng Factory's production pattern is weekly, so the weekly order frequency aligns with production needs.
2. Relationships with suppliers must be maintained to ensure raw materials are delivered on time in larger quantities for a single order.
3. Tapioca flour, as the primary raw material, has a sufficiently long shelf life, so ordering in large quantities does not cause damage as long as storage is managed correctly.

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The LFL MRP method can be applied to other SMEs, particularly in the food production sector, but certain conditions must be met: the SME must have a clear production schedule, accurate raw material requirement data, and stable order lead times. A well-organized information system related to purchasing, usage, and demand is still necessary to support periodic demand calculations, even if the records are kept manually. Additionally, collaboration with suppliers is crucial to ensure raw materials are delivered on time according to fluctuating needs. By meeting these conditions, the MRP LFL method can help SMEs reduce inventory costs and avoid excess stock.

CONCLUSION

The overall expense of tapioca flour raw material stock at the ABC Factory for the duration of July 2023 to June 2024, according to the company's calculation, is IDR 11,197,514,500, involving an annual raw material acquisition of 525,400 kg and an ordering frequency of 200 times. Employing the JIT approach yields a total inventory expense of IDR 35,667,065, with an ideal order size of 1,035 kg per order and a yearly ordering frequency of 502 times. Simultaneously, the MRP approach employing the LFL technique yields overall inventory expenses of IDR 10,067,554,320, with a cumulative order amount of 474,950 kg and a yearly order frequency of 44 times. Applying the EOQ approach of MRP leads to overall inventory expenses of IDR 10,790,524,400, with an aggregate order quantity of 509,760 kg and an annual order frequency of 10 times. Implementing the Just in Time (JIT) method at the ABC Cireng Factory is challenging due to the extremely high order frequency, which would impose operational strains. The MRP approach utilising the Lot for Lot (LFL) technique can lower overall inventory expenses by modifying the quantity to align with net demand and decreasing the frequency of orders. At the same time, the MRP approach utilising the Economic Order Quantity (EOQ) method can lower overall inventory expenses, yet the order size for each order exceeds warehouse capacity. Thus, the MRP approach employing the LFL technique is the most effective method to utilise at the ABC Cireng Factory.

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