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# Control of Raw Material Inventories N-108 and L-107 Using the Material Requirements Planning Method

**Amelia Nur Aini[1*], Elly Ismiyah[2], Yanuar Pandu Negoro[3]**
Universitas Muhammadiyah Gresik, Gresik, Indonesia
*Corresponding Authors: ameliianurra16@gmail.com

**ABSTRACT**

*This study examined the inventories of N-108 and L-107, two raw materials used to produce emulsion paint and paper resin at a chemical manufacturer. It aimed to identify the ordering policy that minimized inventory costs while meeting material requirements from January through June 2026. Monthly opening stocks, receipts, usage, and closing balances were checked for consistency. A three-month moving average and single exponential smoothing were compared using mean absolute percentage error. A retrospective material requirements planning simulation compared lot-for-lot, economic order quantity, and period order quantity using historical warehouse issues as gross requirements, safety stock limits, and a one-month procurement lead time. Single exponential smoothing gave the lowest forecast error for N-108 (25.52%), whereas the moving average performed best for L-107 (24.99%). Their July forecasts were 247.21 and 422.33 kg, respectively. Opening stock met all N-108 requirements without new orders and left 358 kg at the end of June. Under period order quantity, L-107 required three receipts totaling 1,918 kg and ended with 214 kg, equal to its safety stock. This policy gave the lowest combined inventory cost of IDR 5,024,523, which was 54.41% below the estimated cost of historical practice, and remained the least costly across all 12 sensitivity scenarios. The findings support using available N-108 stock before reordering and grouping L-107 demand in two-month cycles. The schedule helps production planning staff determine when and how much to purchase while limiting excess stock. Implementation requires validation against production schedules, material usage coefficients, open purchase orders, and actual inventory costs.*

***Keywords:*** *Inventory Control, Material Requirements Planning, Lot Sizing, Period Order Quantity, Total Inventory Cost.*

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## INTRODUCTION

Raw material inventory control is a critical part of production activities because companies must ensure that materials are available in sufficient quantities, at the right time, and at an efficient cost. Errors in determining purchase quantities can lead to inventory buildup, increased storage costs, or material shortages that hinder production. This problem was identified at a chemical company that uses raw materials N-108 and L-107 to produce emulsion paint and paper resin. Based on data from January–June 2026, the average opening inventory of N-108 was 2,309.33 kg, while the average monthly consumption was only 326.50 kg; thus, the opening inventory was equivalent to 7.07 times the monthly requirement. Meanwhile, L-107 has an average opening inventory of 899.17 kg and a monthly consumption of 438.50 kg, with a ratio of 2.05 times. The discrepancy between inventory levels and consumption highlights the need to evaluate purchasing policies, although not all inventory can be deemed excess, as safety stock requirements and production schedules must be taken into account. This situation becomes even more critical because the procurement of both materials requires a one-month lead time. Therefore, the company needs raw material requirements plan that can control costs while ensuring the smooth operation of production.

Previous research has shown that the inventory control method that results in the lowest costs can vary from one company to another. [1] found that the Economic Order Quantity (EOQ) method can reduce chemical inventory costs by 22%, while [2] showed that the Period Order Quantity (POQ) method is more economical for bag fabric inventory. These differences indicate that the choice of method is influenced by material requirements, ordering costs, storage costs, and purchasing patterns. In an international study, Sereshti et al. (2024) explained the importance of setting order quantities and service levels in a multi-level production system with uncertain demand. [3] developed an order-quantity planning model for multiple material types and production stages while accounting for demand uncertainty. Meanwhile, [4] highlighted the importance of lead time and the risk of product deterioration in inventory policies. These studies show that inventory control is not merely about determining the most cost-effective purchase quantity but must also consider ordering timing, material availability, and the risk of stockouts. However, due to differing approaches and operational conditions, the results cannot be directly applied to the company under study in this research without testing using the company's actual data.

Various studies have addressed order quantity determination, safety stock, and planning for several types of raw materials, but have not provided a direct answer regarding the most appropriate method for the inventory conditions of N-108 and L-107 in the context of chemical research. Both materials are used in two types of products; therefore, purchasing decisions must take into account combined demand, available inventory, and material arrival times. Furthermore, comparisons of the EOQ, Lot-for-Lot (LFL), and POQ methods may yield less-than-optimal decisions if the calculations ignore initial inventory, use different cost periods, or fail to account for safety stock. In the data from the chemical company studied here, discrepancies were also found between some reported inventory balances and the results of calculations based on material receipts and usage. Thus, the issue under investigation is not merely determining the method with the lowest cost, but rather how to make ordering decisions that are consistent with inventory data, monthly requirements, safety stock limits, and procurement lead times. This analysis is necessary before a company selects the inventory policy to be implemented.

The novelty of this study lies in its integrated evaluation of inventory data accuracy checks, a comparison of order quantity methods, and Material Requirements Planning (MRP) simulations for two raw materials used in a multi-product production system. Unlike approaches that merely compare the calculated results of EOQ, LFL, and POQ, this study first examines the consistency of the opening balance, receipts, usage, and closing balance of raw materials. Next, the three methods are compared using the same planning period and cost basis, incorporating the opening inventory, safety stock, and a one-month lead time into the monthly MRP simulation. This study also examines the accuracy of the forecasting methods and conducts a sensitivity analysis regarding changes in demand, ordering costs, and holding costs of ±10% and ±20%. This approach allows for an evaluation based not only on the lowest cost but also on the policy's ability to meet material needs and maintain minimum inventory levels. However, because the production plan data and the composition of materials per product are incomplete, the simulation uses historical consumption as the basis for demand and does not yet constitute a fully validated multi-product MRP.

This study aims to evaluate and determine an inventory control policy for N-108 and L-107 that results in the lowest inventory costs while still meeting raw material needs during the planning period. Specifically, the study was conducted to examine the accuracy of inventory balances for January–June 2026, evaluate the results of demand forecasting, calculate ordering and holding costs, and compare the Total Inventory Cost (TIC) under the LFL, EOQ, and POQ methods. Furthermore, the study developed a monthly MRP simulation by considering the opening inventory, safety stock, and a one-month lead time, then tested how results changed due to variations in demand and costs. The scientific contribution of this study is to provide empirical evidence regarding the influence of opening inventory levels and minimum inventory thresholds on the selection of order quantity methods. Its practical contribution is to provide a basis for planning purchase quantities and timing that the Production Planning and Inventory Control (PPIC) department can use to reduce unnecessary purchases, control inventory costs, and anticipate material shortages. The research results consist of recommendations based on simulations that still require validation using actual production data, purchase transactions, and actual costs before they can be implemented by the company.

## METHOD

### Collection and Review of Inventory Data

This study was conducted at a chemical manufacturing company using data on raw materials N-108 and L-107 from January through June 2026. Data were obtained through documentation, observation, and interviews with the warehouse department and the Production Planning and Inventory Control (PPIC) department, covering opening inventory, receipts, usage, inventory costs, and order lead times. Verification was performed by comparing the ending balances based on monthly records with the balances calculated sequentially from the previous month. If discrepancies were found, the data had to be verified using warehouse stock cards without adding unrecorded transactions.

### Inventory Cost Calculation

Annual ordering expenditure of Rp35,792,406 divided by 120 transactions gives S = Rp298,270.05 per order. Dividing the warehouse allocation of Rp565,200,000 by annual material throughput of 126,619.93 kg gives H= Rp4,463.75 per kg-year, rounded to two decimals. The model uses these rates throughout. In each month, inventory rises by the receipt at the start of the month and falls uniformly with usage. In Eq. (1), $I_{at}$ is stock immediately after receipt and $I_{et}$ is month-end stock. The number of orders, n, counts one transaction per material per month with a positive receipt. The reconstructed policy uses recorded receipts and carries its calculated closing balance into the following month. All inventory costs exclude the purchase price.

$$TIC = nS + \sum_{t=1}^{6} \left( \frac{I_{at} + I_{et}}{2} \times \frac{H}{12} \right) \quad (1)$$

### Raw Material Demand Forecasting

Raw material demand forecasting was performed using the three-period Moving Average (MA-3) and Single Exponential Smoothing (SES) methods based on consumption data from January through June 2026. The MA-3 method calculates the average consumption over the previous three months, while SES assigns greater weight to

the most recent data [4], [5]. Forecasting accuracy is assessed using the Mean Absolute Percentage Error (MAPE), with a smaller value indicating a lower forecasting error [6], [7]. July is forecast from data through June. Both methods are scored on one-step forecasts for April–June, using actual observations through the preceding month. SES starts with the February forecast equal to January usage. The reported N-108 coefficient is α = 0.773852. For L-107, the original coefficient is undocumented, so α is estimated on January–March by minimizing squared one-step errors. With a fixed February forecast, only the March residual identifies α.

$$MA_{3,t} = \frac{D_{t-1} + D_{t-2} + D_{t-3}}{3} \quad (2)$$

$$F_{t+1} = \alpha D_t + (1 - \alpha)F_t \quad (3)$$

$$MAPE = \frac{100\%}{n}\sum_{t=1}^{n}\left|\frac{D_t - F_t}{D_t}\right| \quad (4)$$

**Determining Order Quantity**

Order quantities are determined using three methods: Lot-for-Lot (LFL), Economic Order Quantity (EOQ), and Period Order Quantity (POQ) [8], [9]. The LFL method determines the order quantity based on net demand; the EOQ method determines the order quantity based on ordering and holding costs; and the POQ method determines the ordering interval based on the EOQ and average monthly demand [10], [11]. Annual demand D is twice total January–June usage. Annual theoretical EOQ cost is (D/Q*)S + (Q*/2)H, excluding safety stock. The MRP simulation rounds Q* to the nearest whole kilogram and orders enough whole lots to cover the net requirement. The POQ interval is Q* divided by mean monthly usage, rounded to the nearest whole month with a minimum of one. At a shortage, POQ covers demand through that interval, capped at June, plus safety stock less available inventory.

$$EOQ = \sqrt{\frac{2DS}{H}} \quad (5)$$

$$POQ = \frac{EOQ}{D/12} \quad (6)$$

**Determining Safety Stock and the Reorder Point**

Safety stock is calculated based on the standard deviation of raw material consumption over a six-month period, using a service level factor (Z) of 1.65. The reorder point is determined based on the average demand over a one-month lead time plus the safety stock [12], [13]. Both safety stock and the reorder point are rounded upward to whole kilograms. ROP uses mean monthly usage multiplied by lead time plus the rounded safety stock. Monthly MRP receipts are triggered by the projected net requirement.

$$s = \sqrt{\frac{\sum_{t=1}^{n}(D_t - \bar{D})^2}{n - 1}} \quad (7)$$

$$SS = \lceil Zs\sqrt{L} \rceil \quad (8)$$

$$ROP = \lceil \bar{D}L + SS \rceil \quad (9)$$

**Raw Material Requirements Planning Using MRP**

Raw material requirements planning is conducted using Material Requirements Planning (MRP) through the stages of netting, lotting, and offsetting to determine net requirements, order quantities, and order timing. Gross requirements are based on historical warehouse issuance data because production plan data and material usage quantities per product are not yet complete, while scheduled receipts in the proposed policy simulation are assumed to be zero because current order data is not yet available [1], [3]. Receipt quantities are planned based on the LFL, EOQ, or POQ methods, ensuring that the ending inventory does not fall below the safety stock level, while orders are placed one month prior to receipt in accordance with the procurement lead time [14], [15].

$$NR_t = \max\{0, GR_t + SS - (PAB_{t-1} + SR_t)\} \quad (10)$$

$$PAB_t = PAB_{t-1} + SR_t + POR_t - GR_t \quad (11)$$

$$POL_{t-1} = POR_t \quad (12)$$

**Sensitivity Analysis**

A sensitivity analysis was conducted to determine the impact of changes in raw material demand, ordering costs, and storage costs on order quantity and TIC. Each variable was increased or decreased by 10% and 20% separately, while the other variables were held constant [16], [17]. For each change in demand, the standard deviation, safety stock, EOQ, and POQ interval were recalculated, while changes in costs were used to recalculate the EOQ, POQ, and TIC. The results of each scenario were compared over a six-month period to identify the method with the lowest cost, with the limitation that the feasibility of the ordering schedule prior to January 2026 could not yet be confirmed [18], [19]. Scenario demand is applied to each month for both materials. Fractional kilograms

from these changes are retained in demand and in LFL and POQ receipts. Initial stocks are held fixed. Costs are accumulated before rounding to the nearest rupiah.

## RESULTS

Table 1 presents the monthly inventory balance for N-108 from January to June 2026. Closing stock was obtained by adding receipts to opening stock and subtracting usage.

*Table 1. Inventory Balance Verification for Raw Material N-108*

| Month | Opening Stock (kg) | Receipts (kg) | Usage (kg) | Closing Balance (kg) |
|---|---|---|---|---|
| Jan | 2,313 | 200 | 387 | 2,126 |
| Feb | 2,126 | 507 | 355 | 2,278 |
| Mar | 2,278 | 480 | 367 | 2,391 |
| Apr | 2,391 | 175 | 378 | 2,188 |
| May | 2,188 | 602 | 224 | 2,566 |
| Jun | 2,566 | 0 | 244 | 2,322 |
| Total | — | 1,964 | 1,955 | — |

Each month's closing stock from January to May matched the following month's opening stock, confirming that the N-108 balances were consistent. The largest stock increase occurred in May, when receipts of 602 kg exceeded usage of 224 kg and raised closing stock to 2,566 kg. Over the full six months, receipts exceeded usage by only 9 kg, so June closed at 2,322 kg, close to the January opening stock.

Table 2 tracks changes in L-107 inventory based on the quantities received and used each month.

*Table 2. Inventory Balance Verification for Raw Material L-107*

| Month | Opening Stock (kg) | Receipts (kg) | Usage (kg) | Closing Balance (kg) |
|---|---|---|---|---|
| Jan | 927 | 200 | 575 | 552 |
| Feb | 552 | 435 | 258 | 729 |
| Mar | 729 | 900 | 531 | 1,098 |
| Apr | 1,098 | 200 | 547 | 751 |
| May | 751 | 950 | 369 | 1,332 |
| Jun | 1,332 | 0 | 351 | 981 |
| Total | — | 2,685 | 2,631 | — |

L-107 reached its lowest closing stock in January at 552 kg because usage exceeded receipts by 375 kg. The largest increase occurred in May, when receipts of 950 kg raised the balance from 751 kg to 1,332 kg. These changes show how the timing and size of receipts affected monthly stock, even though total receipts exceeded total usage by only 54 kg over the six months.

### Raw Material Demand Forecasting

The accuracy of the three-month moving average (MA-3) and single exponential smoothing (SES) was compared using the same three months, April to June. Table 3 also presents the forecast for July.

*Table 3. Monthly one-step forecasts and April–June forecast error*

| Material | Method | SES α | Apr (kg) | May (kg) | Jun (kg) | Jul (kg) | MAPE (%) |
|---|---|---|---|---|---|---|---|
| N-108 | MA-3 | — | 369.67 | 366.67 | 323.00 | 282.33 | 32.76 |
| N-108 | SES | 0.773852 | 365.92 | 375.27 | 258.21 | 247.21 | 25.52 |
| L-107 | MA-3 | — | 454.67 | 445.33 | 482.33 | 422.33 | 25.00 |
| L-107 | SES | 0.138801 | 531.00 | 533.22 | 510.43 | 488.30 | 30.95 |

SES gave the lowest MAPE for N-108 at 25.52%, mainly because its June forecast was closer to actual usage than the MA-3 forecast. Both methods overestimated May usage after it dropped from 378 kg in April to 224 kg. For L-107, MA-3 gave the lowest MAPE at 24.99%. Based on the three-month evaluation, the selected methods forecast July usage of 247.21 kg for N-108 and 422.33 kg for L-107.

### Determining Order Quantity

Annual demand was estimated by doubling the six-month usage. Table 4 uses this estimate and the ordering and holding costs to determine the EOQ lot sizes and POQ intervals.

*Table 4. Annualized demand, EOQ cost and POQ interval*

| Material | 6-month use (kg) | Annual D (kg) | Q* (kg) | MRP lot (kg) | Lots per year | Annual EOQ cost (IDR) | POQ months[1] | 12 orders[2] (IDR) |
|---|---|---|---|---|---|---|---|---|
| N-108 | 1,955 | 3,910 | 722.87 | 723 | 5.41 | 3,226,697 | 2.22 → 2 | 3,579,241 |
| L-107 | 2,631 | 5,262 | 838.58 | 839 | 6.27 | 3,743,218 | 1.91 → 2 | 3,579,241 |

L-107 had higher estimated annual demand and therefore a larger EOQ lot of 839 kg, compared with 723 kg for N-108. Its higher monthly usage also meant that this larger lot covered a shorter period. The estimated POQ intervals were 1.91 months for L-107 and 2.22 months for N-108. Both were rounded to two months for the inventory simulation.

### Determining Safety Stock and Reorder Point

Table 5 shows the stock buffers needed to cover changes in monthly usage and the stock levels that trigger reordering. Both materials had a lead time of one month.

*Table 5. Safety stock and reorder point from six months of usage*

| Material | Mean usage (kg/month) | Sample SD (kg) | Lead time (months) | Safety stock (kg) | ROP (kg) |
|---|---|---|---|---|---|
| N-108 | 325.83 | 72.21 | 1 | 120 | 446 |
| L-107 | 438.50 | 129.64 | 1 | 214 | 653 |

Monthly usage varied more for L-107, giving it a safety stock of 214 kg, which was 94 kg higher than the 120 kg set for N-108. L-107 also had higher average monthly usage. Together, these two factors explain why its reorder point was 653 kg, compared with 446 kg for N-108, under the same one-month lead time.

### Raw Material Requirements Planning Using MRP

Table 6 tests whether the January opening stock of N-108 could cover demand through June. Monthly warehouse issues were used as demand, and receipts from existing orders were set to zero because open-order data were unavailable.

*Table 6. Monthly POQ plan for N-108, January–June 2026 (kg)*

| Month | Opening stock | Gross need | Scheduled receipt | Net need | Planned receipt | Planned release | Closing stock |
|---|---|---|---|---|---|---|---|
| Jan | 2,313 | 387 | 0 | 0 | 0 | 0 | 1,926 |
| Feb | 1,926 | 355 | 0 | 0 | 0 | 0 | 1,571 |
| Mar | 1,571 | 367 | 0 | 0 | 0 | 0 | 1,204 |
| Apr | 1,204 | 378 | 0 | 0 | 0 | 0 | 826 |
| May | 826 | 224 | 0 | 0 | 0 | 0 | 602 |
| Jun | 602 | 244 | 0 | 0 | 0 | 0 | 358 |

The January opening stock of 2,313 kg covered all 1,955 kg of N-108 usage through June without a new order in the simulation. The projected June closing stock was 358 kg, leaving 238 kg above the safety stock. This explains why the choice of lot-sizing method had no effect on N-108 ordering costs during the study period.

Table 7 shows how POQ groups up to two months of L-107 demand into one receipt. Each order is placed one month before the material is due to arrive.

*Table 7. Monthly POQ plan for L-107, January–June 2026 (kg)*

| Month | Opening Stock (kg) | Gross Requirement (kg) | Scheduled Receipt (kg) | Net Requirement (kg) | Planned Receipt (kg) | Planned Order Release (kg) | Closing Stock (kg) |
|---|---|---|---|---|---|---|---|
| Jan | 927 | 575 | 0 | 0 | 0 | 651 | 352 |
| Feb | 352 | 258 | 0 | 120 | 651 | 0 | 745 |
| Mar | 745 | 531 | 0 | 0 | 0 | 916 | 214 |
| Apr | 214 | 547 | 0 | 547 | 916 | 0 | 583 |
| May | 583 | 369 | 0 | 0 | 0 | 351 | 214 |
| Jun | 214 | 351 | 0 | 351 | 351 | 0 | 214 |

The first net requirement occurred in February, when January's closing stock could no longer cover February demand and maintain the safety stock. POQ scheduled 651 kg for February and 916 kg for April, with each receipt covering demand for two months. The final receipt of 351 kg covered June alone because the simulation ended that month. The plan met all monthly requirements and kept closing stock at or above 214 kg.

### Comparison of Total Inventory Cost (TIC)

Table 8 compares the six-month ordering and holding costs for each material under LFL, EOQ, and POQ. The historical cost estimate assumes one order per material in each month with a receipt.

*Table 8. Orders, Receipts and Six-Month Inventory Costs by Material and Policy*

| Material | Policy | Orders | Receipts (kg) | Ordering Cost (IDR) | Holding Cost (IDR) | Six-Month TIC (IDR) | June Closing Stock (kg) |
|---|---|---|---|---|---|---|---|
| N-108 | Historical Cost | 5 | 1,964 | 1,491,350 | 5,523,333 | 7,014,683 | 2,322 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| N-108 | LFL | 0 | 0 | 0 | 2,776,638 | 2,776,638 | 358 |
| N-108 | EOQ | 0 | 0 | 0 | 2,776,638 | 2,776,638 | 358 |
| N-108 | POQ | 0 | 0 | 0 | 2,776,638 | 2,776,638 | 358 |
| L-107 | Historical Cost | 5 | 2,685 | 1,491,350 | 2,514,021 | 4,005,371 | 981 |
| L-107 | LFL | 5 | 1,918 | 1,491,350 | 1,018,293 | 2,509,643 | 214 |
| L-107 | EOQ | 3 | 2,517 | 894,81 | 1,798,333 | 2,693,143 | 813 |
| L-107 | POQ | 3 | 1,918 | 894,81 | 1,353,074 | 2,247,884 | 214 |

For L-107, POQ and LFL both received 1,918 kg, but POQ combined the same quantity into three orders instead of five. The resulting reduction in ordering costs exceeded the increase in holding costs. EOQ also used three orders, but its fixed lots brought in 599 kg more than POQ and left 813 kg at the end of June. This explains why POQ had the lowest total cost for L-107.

Table 9 adds the costs of N-108 and L-107 to compare the three ordering methods and the estimated historical cost over the same six-month period.

*Table 9. Combined Six-Month Total Inventory Cost (IDR)*

| Policy | N-108 (IDR) | L-107 (IDR) | Combined TIC (IDR) |
|---|---|---|---|
| Historical Cost | 7,014,683 | 4,005,371 | 11,020,054 |
| LFL | 2,776,638 | 2,509,643 | 5,286,282 |
| EOQ | 2,776,638 | 2,693,143 | 5,469,782 |
| POQ | 2,776,638 | 2,247,884 | 5,024,523 |

POQ gave the lowest combined six-month cost at IDR 5,024,523, which was 54.41% below the estimated historical cost of IDR 11,020,054. About 71% of the estimated savings came from N-108, whose opening stock was already sufficient to meet six months of usage. L-107 determined the ranking among LFL, EOQ, and POQ because all three methods had the same cost for N-108.

Figure 1 compares actual N-108 usage with forecasts from single exponential smoothing (SES). The first forecast beyond the observed data is for July 2026.

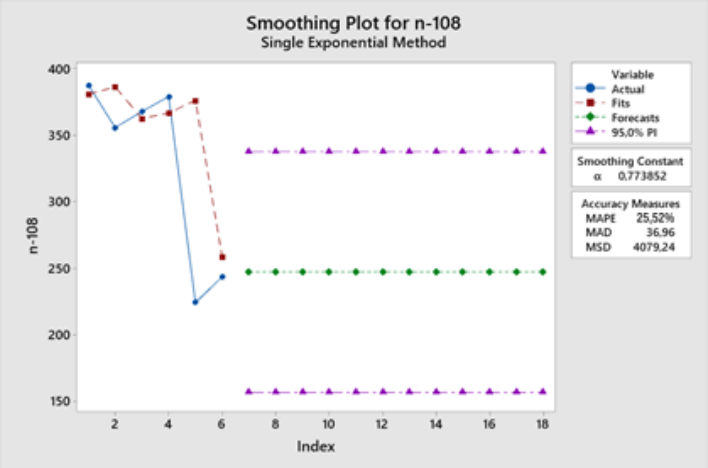



*Figure 1. Recorded usage and SES forecasts for N-108*

N-108 usage fell from 378 kg in April to 224 kg in May, while the May forecast was still 375.27 kg. Once the model incorporated the lower May usage, the June forecast fell to 258.21 kg, just 14.21 kg above actual usage. This shows that SES adjusted quickly after the drop. The July forecast was 247.21 kg.

Figure 2 shows how the three-month moving average (MA-3) follows changes in L-107 usage. Each forecast uses the average usage of the preceding three months.

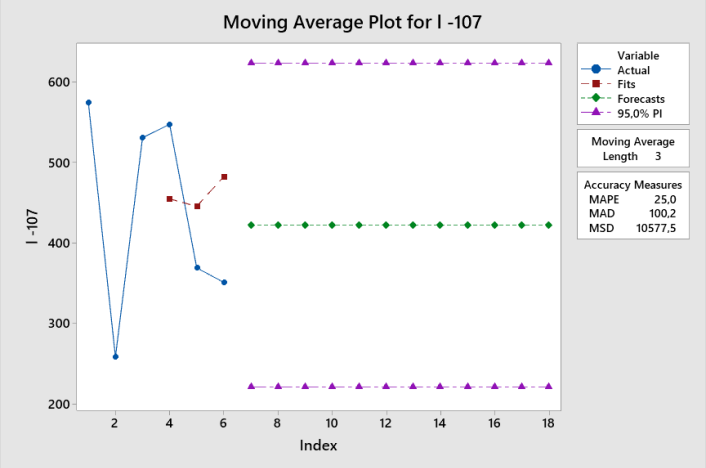



*Figure 2. Recorded usage and MA-3 forecasts for L-107*

L-107 usage declined from 547 kg in April to 369 kg in May and 351 kg in June. MA-3 overestimated usage in May and June because the preceding months included higher usage. The July forecast of 422.33 kg remained above actual June usage because the three-month average still included April.

### Sensitivity Analysis

Table 10 tests whether the lowest-cost method changes when demand, ordering cost, or holding cost rises or falls by 10% or 20%. Each scenario changes one factor at a time.

*Table 10. Combined six-month inventory cost in the base case and 12 sensitivity scenarios (IDR)*

| Variable | Change | LFL (IDR) | EOQ (IDR) | POQ (IDR) | Lowest-Cost Method |
|---|---|---|---|---|---|
| Base case | 0% | 5,286,282 | 5,469,782 | 5,024,523 | POQ |
| Demand | −20% | 5,364,901 | 5,408,611 | 5,035,591 | POQ |
| Demand | −10% | 5,458,248 | 5,872,338 | 5,163,011 | POQ |
| Demand | 10% | 5,116,176 | 5,387,872 | 4,887,895 | POQ |
| Demand | 20% | 5,613,658 | 6,263,007 | 5,234,857 | POQ |
| Ordering cost | −20% | 4,988,012 | 5,271,849 | 4,845,561 | POQ |
| Ordering cost | −10% | 5,137,147 | 5,236,345 | 4,935,042 | POQ |
| Ordering cost | 10% | 5,435,417 | 5,696,523 | 5,114,004 | POQ |
| Ordering cost | 20% | 5,584,552 | 5,916,569 | 5,203,485 | POQ |
| Holding cost | −20% | 4,527,295 | 4,819,934 | 4,198,580 | POQ |
| Holding cost | −10% | 4,906,789 | 5,147,871 | 4,611,552 | POQ |
| Holding cost | 10% | 5,665,775 | 5,783,658 | 5,437,494 | POQ |
| Holding cost | 20% | 6,045,268 | 6,433,431 | 5,850,465 | POQ |

POQ remained the lowest-cost method in all 12 scenarios when demand, ordering cost, or holding cost changed by 10% or 20%, one factor at a time. The demand increases of 20% also changed the timing of the first L-107 receipt. Under POQ, 329.6 kg would have to arrive in January, which means the order would have to be placed in December 2025. The cost shown for that scenario therefore depends on the feasibility of placing the order before the study period.

## DISCUSSION

The inventory balance check showed that the closing stock for each month from January to May matched the opening stock of the following month for both materials. The forecast evaluation identified SES as the more accurate method for N-108 and MA-3 for L-107 over April–June. The July forecasts were 247.21 kg and 422.33 kg, respectively. These estimates describe expected usage for the following month. The January–June cost comparison used actual monthly warehouse issues to assess how each ordering method would have performed over the study period.

POQ gave the lowest combined inventory cost at IDR 5,024,523, or 54.41% below the estimated historical cost. About 71% of this reduction came from N-108 because its opening stock covered six months of usage under all three methods. The advantage of POQ came from L-107. POQ and LFL both received 1,918 kg, but POQ reduced the number of orders from five to three. The savings from two fewer orders exceeded the extra cost of holding stock

between receipts. This finding agrees with [8], who reported lower costs under POQ for bag fabric, and with [21], who found that POQ shared the lowest cost with two other methods in cigarette manufacturing. garuda.kemdiktisaintek.go.id

The result differed from that of [15], who found the lowest cost under EOQ for a laboratory solvent, and from that of [23], who favored LFL for motorcycle-chain materials. In the present study, EOQ and POQ both required three orders for L-107. The fixed EOQ lots, however, brought in 599 kg more than POQ and increased holding costs over the six-month period. The comparison shows why the preferred method depends on the stock already available, the timing of demand, and the balance between ordering and holding costs. ejournal.uniramalang.ac.id

POQ remained the lowest-cost method in all 12 sensitivity scenarios. A 20% rise in demand nevertheless brought the first L-107 receipt forward to January, which would require an order in December 2025. [16] extend this type of analysis by considering uncertain demand together with production capacity. [7] also show that forecast accuracy and inventory costs can favor different choices. For this study, the next practical test is whether the July forecasts support timely purchases and adequate stock when used with the production schedule, material requirements per product, and confirmed supplier lead times. The estimated savings also depend on the assumed number of historical orders and the warehouse costs allocated to each material.

## CONCLUSION

Period order quantity (POQ) was the lowest-cost inventory policy that met all simulated requirements for N-108 and L-107 from January through June 2026. Its combined ordering and holding cost were IDR 5,024,523, compared with IDR 5,286,282 for lot-for-lot and IDR 5,469,782 for economic order quantity. The monthly stock balances reconciled for both materials, and single exponential smoothing produced the lowest forecast error for N-108, while the three-month moving average performed best for L-107. The opening stock of N-108 covered all six months of usage without new orders and left 358 kg, above its 120 kg safety stock. For L-107, POQ scheduled receipts of 651 kg in February, 916 kg in April, and 351 kg in June, while keeping month-end stock at or above 214 kg. POQ remained the lowest-cost policy in all 12 sensitivity scenarios. These results support using available N-108 stock before reordering and grouping L-107 requirements into two-month ordering cycles, subject to verification of production needs, open purchase orders, and actual costs.

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**CONFLICT OF INTEREST**
The authors declare no conflicts of interest related to this study.

**DATA AVAILABILITY STATEMENT**
The monthly inventory data, cost parameters, and simulation results used in this study are presented in the article. Requests for the original warehouse records may be directed to the corresponding author and are subject to the company's approval.

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