COMPARATIVE ANALYSIS OF ECONOMIC ORDER QUANTITY AND JUST IN TIME METHODS FOR POLYESTER INVENTORY CONTROL

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Abstract

Polyester is the core raw material for the production process at PT Indo-Rama Technologies Complex, and inconsistent inventory control caused overstock conditions and rising holding costs at the Raw Material Godown (RMG) Department. This study aimed to determine the optimal order quantity and the minimum Total Inventory Cost (TIC) of polyester raw material by comparing the company's existing policy with the Economic Order Quantity (EOQ) and Just in Time (JIT) methods. A quantitative descriptive approach was applied using five months of inventory and demand data, with ordering cost and holding cost as the main variables. The results showed that the existing company policy generated an order quantity of 6,124 units with a TIC of Rp11,190,975.05. The EOQ method produced an optimal order quantity of 17,751 units with two order frequencies and a TIC of Rp6,900,459, saving about 38.3% compared to the existing policy. The JIT method mathematically produced the lowest TIC (Rp3,983,981.86) but required an unrealistic order frequency of 133 times in five months. Considering operational feasibility, supplier lead time, and import administration constraints, the EOQ method was concluded to be the most efficient and applicable inventory control policy for polyester raw material.

Keywords: *Economic Order Quantity; Just in Time; Inventory Control; Total Inventory Cost; Polyester*

A. INTRODUCTION

PT Indo-Rama Technologies Complex is one of the large integrated textile companies that plays an important role in supplying both national and global textile markets. Polyester is the core raw material that determines product quality as well as the stability of the yarn production process at the company. Based on field observations at the Raw Material Godown (RMG) Department, the current inventory control system still faces efficiency challenges, as the monthly inventory level consistently exceeds actual demand, resulting in overstock conditions that increase holding costs.

Inventory is one of the fundamental issues in company operations management. Overstock conditions create unnecessary holding costs, while understock conditions may cause lost production opportunities and reduced customer trust. Two commonly used inventory control approaches to address these issues are Economic Order Quantity (EOQ) and Just In Time (JIT). EOQ focuses on determining the optimal order quantity that minimizes total ordering and holding costs, whereas JIT is a management philosophy that seeks to eliminate waste by supplying raw materials only when needed in the exact amount required, so that inventory levels approach zero (zero inventory). The implementation of EOQ still requires inventory to avoid raw material shortages, while JIT seeks to eliminate inventory in order to reduce waste (Jannah et al., 2024).

Studies comparing EOQ and JIT have been widely conducted on various industrial objects, including bread raw materials (Fachrezy & Setiafindari, 2024), pipes at manufacturing companies (Sofina et al., 2025), bogie-SCT materials in the railway industry (Jannah et al.,

2024), tofu raw materials (Rafi et al., 2024), as well as material procurement at general manufacturing companies (Heitasari & Revalina, 2025; Latifah & Marlyana, 2025; Paxidda et al., 2024). Other studies have also emphasized the important role of JIT in improving operational efficiency in the Indonesian industry (Budiandriani et al., 2025; Ramlawati et al., 2025), as well as the benefits of EOQ optimization in reducing inventory costs across various types of businesses (Gusniar et al., 2022; Herawati et al., 2024; Wardhani & Sukmono, 2024; Widajanti, 2024; Wijaya et al., 2021). However, research that specifically examines the comparison of EOQ and JIT for polyester textile raw materials at a large industrial scale, while considering the feasibility of international supply chain operations, remains limited.

Based on the description above, this study aimed to (1) calculate the optimal polyester order quantity using the EOQ and JIT methods, (2) calculate the Total Inventory Cost (TIC) based on both methods, and (3) determine which method is the most efficient and realistic to implement at the RMG Department of PT Indo-Rama Technologies Complex.

B. METHODS

This study used a quantitative descriptive approach to describe, calculate, and compare the condition of polyester raw material inventory control. The research was conducted at the Raw Material Godown (RMG) Department of PT Indo-Rama Technologies Complex, Purwakarta, West Java, over one month of field data collection. The data used included inventory and demand data for polyester raw material over five months (December-April), ordering cost, and holding cost. Data were collected through direct observation of the ordering, storage, and usage processes of raw materials, as well as interviews with RMG staff regarding the inventory policy applied by the company.

Notation:

D = Total demand
Q = Order quantity per order
f = Order frequency (company policy)
S = Ordering cost
H = Holding cost per unit
EOQ = Economic order quantity
F = Order frequency using the EOQ method
TIC = Total Inventory Cost
na = Optimal number of deliveries under the JIT method
a = Average demand
Qn = Order quantity per delivery
q = Average quantity per small cycle
N = Order frequency using the JIT method
T = Total inventory cost obtained from the EOQ method
TJIT = Total inventory cost using the JIT method

Before applying the EOQ and JIT methods, the average demand (Q) and Total Inventory Cost (TIC) based on the company's existing policy were first calculated:

$$Q = \frac{D}{f} \quad (1)$$

$$TIC = \left(\frac{D}{Q}S\right) + \left(\frac{Q}{2}H\right) \quad (2)$$

The optimal order quantity, order frequency, and total inventory cost using the EOQ method were calculated using the following equations:

$$EOQ = \sqrt{\frac{2.S.D}{H}} \quad (1)$$

$$F = \frac{D}{EOQ} \quad (2)$$

$$TIC(EOQ) = \left(\frac{D}{EOQ}S\right) + \left(\frac{EOQ}{2}H\right) \quad (3)$$

The JIT calculation began with determining the optimal number of deliveries (na), the order quantity per delivery (Qn), the average quantity per small cycle (q), the order frequency (N), and the total inventory cost (TJIT):

$$na = \frac{Q}{2a} \quad (1)$$

$$Qn = \sqrt{na.EOQ} \quad (2)$$

$$q = \frac{Qn}{n} \quad (3)$$

$$N = \frac{Q}{Qn} \quad (4)$$

$$TJIT = \frac{1}{\sqrt{n}}(T) \quad (5)$$

Where a is the average demand and T is the total inventory cost obtained from the EOQ method.

The results of the three scenarios (company policy, EOQ, and JIT) were compared based on order quantity, order frequency, and total inventory cost to determine the most efficient method, while also considering operational feasibility aspects such as dependence on international suppliers, delivery lead time, and import administration burden.

C. RESULTS AND DISCUSSION

1. Inventory and Demand Data

Inventory and demand data for polyester raw material needed for yarn production during the December-April period are presented in Table 1.

Table 1. Inventory and Demand Data for Polyester Raw Material

Month	Inventory (Units)	Demand (Units)
December	9,658	7,584
January	8,100	7,849
February	8,254	5,033
March	7,376	4,988
April	8,231	5,168
Total	**41,619**	**30,622**
Average	**6,937**	**5,104**

Source: PT Indo-Rama Technologies Complex

Total inventory over the five months was recorded at 41,619 units, while total demand was recorded at 30,622 units, with an average inventory of 6,937 units per month and an average demand of 5,104 units per month. The inventory level in every month consistently exceeded the demand level, indicating a persistent overstock condition throughout the study period.

2. Ordering and Holding Cost Components

Ordering cost covers international purchase administration, communication and coordination with suppliers, import documentation, customs, quality control upon receipt, and order-processing overhead, amounting to a total of Rp2,000,000 per order. Holding cost consists of warehouse maintenance and electricity costs for lighting, CCTV, and exhaust fans in the warehouse, amounting to a total of Rp11,904,085 over five months. Based on the total demand of 30,622 units, the holding cost per unit (H) was obtained at Rp388.74.

Ordering cost covers international purchase administration, communication and coordination with suppliers, import documentation, customs, quality control upon receipt, and order-processing overhead, amounting to a total of IDR 2,000,000 per order. The detailed components of the ordering cost are presented in Table 2.

Table 2. Ordering Cost Components

Cost Component	Estimated Cost (IDR)
International Purchase Administration	300,000
Communication & Coordination with Supplier	250,000
Import Documentation	350,000
Customs & Document Processing	400,000
QC Cost for Polyester Receipt	300,000
Order Processing Overhead	400,000
Total Ordering Cost (S)	**2,000,000**

Source: PT Indo-Rama Technologies Complex

Holding cost consists of warehouse maintenance and electricity costs for lighting, CCTV, and exhaust fans in the warehouse, amounting to a total of IDR 11,904,085 over five months. Based on the total demand of 30,622 units, the holding cost per unit (H) was obtained at IDR 388.74. The detailed components of the holding cost are presented in Table 3.

Table 3. Holding Cost Components Over 5 Months

Item	Quantity	Unit	Cost/Unit (IDR)	Cost/Month (IDR)	Cost/5 Months (IDR)
Disinfectant Cost	4	times	150,000	600,000	3,000,000
Lamp Maintenance Cost	24	units	25,000	600,000	3,000,000
Electricity - Lamp (18 hrs/day)	0.72	kWh	1,444.7	411,913	2,059,565
Electricity - CCTV (24 hrs/day)	0.288	kWh	1,444.7	219,687	1,098,435
Electricity - Exhausting Fan (24 hrs/day)	0.72	kWh	1,444.7	549,217	2,746,085
Total Holding Cost				2,380,817	11,904,085

Source: PT Indo-Rama Technologies Complex.

Holding cost per unit (H) = IDR 11,904,085 / 30,622 units = IDR 388.74/unit.

3. EOQ and JIT Calculation Results

Based on the data collected, the detailed calculations for the Company's Existing Policy, EOQ, and JIT methods are as follows:

a. Company's Existing Policy
   Q = D/f = 30,622/5 = 6,124 units
   TIC = (D/Q)S + (Q/2)H = (30,622/6,124 x 2,000,000) + (6,124/2 x 388.74) = 10,000,653.17 + 1,190,321.88 = Rp11,190,975.05
b. Economic Order Quantity (EOQ) Method
   EOQ = root(2SD/H) = root(2 x 2,000,000 x 30,622 / 388.74) = 17,751 units
   F = D/EOQ = 30,622/17,751 = 1.73 = 2 orders
   TIC(EOQ) = (D/EOQ)S + (EOQ/2)H = (30,622/17,751 x 2,000,000) + (17,751/2 x 388.74) = 3,450,171.82 + 3,450,261.87 = Rp6,900,459 (rounded)
c. Just In Time (JIT) Method
   na = Q/2a = 30,622 / 2(6,124) = 2.50 = 3 deliveries
   Qn = root(na x EOQ) = root(3 x 17,751) = 230.77 units

q = Qn/na = 230.77/3 = 76.92 units
N = Q/Qn = 30,622/230.77 = 132.70 = 133 orders
TJIT = (1/root(na)) x T = (1/root(3)) x 6,900,459 = IDR 3,983,981.86

Under the company's current policy, the average order quantity (Q) is 6,124 units with an order frequency of 5 times, resulting in a TIC of Rp11,190,975.05. Calculation using the EOQ method produced an optimal order quantity of 17,751 units with an order frequency of 2 times over five months, and a TIC of Rp6,900,459. Meanwhile, calculation using the JIT method produced an optimal number of deliveries of 3 times, an order quantity per delivery of 230.77 units, an average quantity per small cycle of 76.92 units, an order frequency of 133 times, and a TJIT of Rp3,983,981.86. A summary of the comparison among the three scenarios is presented in Table 4.

Table 4. Comparison of Company Policy, EOQ Method, and JIT Method

Description	Company Policy	EOQ Method	JIT Method
Total Demand (Units)	30,622	30,622	30,622
Order Quantity (Units)	6,124	17,751	230.77
Order Frequency (Times)	5	2	133
Total Inventory Cost (Rp)	**11,190,975.05**	**6,900,459**	**3,983,981.86**

Source: Data Processing, 2026

The existing condition shows that the company applies a purchasing policy of 6,124 units per order with a frequency of 5 times during the study period. This conventional approach results in the highest TIC among the three scenarios, namely IDR 11,190,975.05, caused by a persistent overstock condition that inflates holding costs.

Mathematically, the JIT method offers the most extreme cost efficiency with the smallest TIC of IDR 3,983,981.86, due to its underlying philosophy of pursuing inventory levels close to zero (zero inventory). However, from the perspective of implementation feasibility on the production floor, JIT has a critical weakness in its order frequency. To achieve that operational cost, JIT requires an order frequency of 133 times within five months with a very small delivery lot quantity of 230.77 units, which, when converted into daily terms, means the company would have to place orders and receive deliveries almost every working day. Such a high delivery frequency is considered impractical to implement due to several limiting factors: (a) dependence on international suppliers, as it is unrealistic for overseas suppliers to deliver micro lots that frequently without disrupting the economies of scale of their own shipments; (b) administrative burden and lead time, since every incoming shipment must undergo quality control inspection and customs document processing, which could create administrative bottlenecks; and (c) the risk of demand fluctuation, given that a pure JIT model assumes a perfectly smooth logistics flow without supply chain disruption, making its strict application highly vulnerable to stockouts. These findings are consistent with previous studies emphasizing that the success of JIT strongly depends on precise supply chain synchronization (Budiandriani et al., 2025; Ramlawati et al., 2025).

Considering the operational limitations of JIT described above, this study recommends the EOQ method as the most adaptive and rational inventory control policy for PT Indo-Rama Technologies Complex. Although the TIC of EOQ (IDR 6,900,459) is higher than that of JIT, this method provides the most balanced trade-off between cost efficiency and management feasibility, with an order quantity of 17,751 units and a logical frequency of only 2 orders over five months. Implementing EOQ is able to cut the company's initial total inventory cost from IDR 11,190,975.05 to IDR 6,900,459, a saving of approximately 38.3%, while also reducing the workload of logistics administration, import documentation, and quality control inspection due to the much lower order frequency. This finding is in line with various studies showing that EOQ optimization consistently reduces total inventory costs for various types of raw materials (Gusniar et al., 2022; Herawati et al., 2024; Sari & Rismawati, 2025; Wardhani &

Sukmono, 2024; Wijaya et al., 2021; Wulansasri et al., 2024). Overall, these results demonstrate that inventory policy decisions should not be based solely on the lowest cost figure on paper, but must also integrate the real capability of the supply chain and the operational feasibility of the company (Satria & Dewi, 2024; Situmeang et al., 2025).

D. CONCLUSION

This study shows that the optimal order quantity of polyester raw material using the EOQ method is 17,751 units with an order frequency of 2 times over five months, while the JIT method produces an order quantity of 230.77 units per delivery with a frequency of 133 times over the same period. The total inventory cost (TIC) based on the company's initial policy was recorded at IDR 11,190,975.05, decreasing to IDR 6,900,459 with the EOQ method, and mathematically to IDR 3,983,981.86 with the JIT method. Although JIT is theoretically superior in terms of cost, its very high order frequency is considered unrealistic to implement due to constraints related to dependence on international suppliers, import administration burden, and stockout risk. Therefore, the EOQ method is concluded to be the most efficient and feasible inventory control policy to implement at the RMG Department of PT Indo-Rama Technologies Complex, as it is able to save inventory costs by up to 38.3% without compromising the stability of production operations. Future research is recommended to complement this analysis with the determination of Reorder Point (ROP) and Safety Stock, as well as to consider external variables such as exchange rate fluctuations and warehouse capacity.

ACKNOWLEDGMENTS

The authors would like to thank the Raw Material Godown (RMG) Department of PT Indo-Rama Technologies Complex for the permission and data assistance provided during the research, as well as the Department of Industrial Engineering, Sekolah Tinggi Teknologi Wastukancana Purwakarta, for the academic guidance provided in preparing this article.

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