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Inventory Control of Cotton Combed 30s Raw Materials to Minimize The Total Inventory Cost of MSMEs Kamal Konveksi Central Lombok

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Abstract

This study aims to control the cotton combed 30s raw materials inventory in Kamal Convection MSMEs in Central Lombok using the EOQ (Economic Order Quantity) and POQ (Period Order Quantity) methods to minimize the total inventory cost. The EOQ and POQ methods are proposed as suggestions for the most optimal improvement of inventory control. The calculations using the company's method show that the purchased quantity of cotton combed 30s raw material supplies an average of 1.843 kg with a purchase frequency of 12 times a year, and a total inventory cost of Rp. 19.363.400. The proposed EOQ method reveals the quantity of inventory purchased is 3.463 kg with a purchase frequency of 6 times in one year, and the total inventory cost is Rp. 13.157.959. Meanwhile, the proposed POQ method indicates the quantity of inventory purchased is 11.059 kg with a purchase frequency of 2 times in one year, and the total inventory cost is Rp. 23.072.100. Based on the calculation results, the use of the EOQ method is the most optimal purchase of cotton combed 30s raw materials to reduce inventory costs. The difference in total inventory cost between the EOQ method and the proposed POQ method is Rp. 9.914.141. The total inventory cost difference between the EOQ and company methods is Rp. 6.205.441. Based on this analysis, controlling the inventory of raw material for cotton combed 30s at Kamal Convection is relatively ineffective. Based on the results of the calculation analysis using the EOQ method, it is the most optimal method for reducing the cost of supplying raw material for cotton combed 30s at Kamal Konveksi.

Keywords: Inventory control; economic order quantity (EOQ); period order quantity (POQ).

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1. Introduction

In order to maintain business growth and development, companies need to implement an inventory control system which has an important role in supporting business operations and achieving maximum profits. The inventory system must have optimal inventory control and planning techniques to minimize the risk of excess and shortage of raw materials. Inventory refers to all goods stored to meet demand and maintain an optimal amount of inventory. As a company, it is important to determine the right amount of inventory as improper control can cause losses both on a small and large scale. Therefore, inventory planning and control is required to achieve optimal results and costs in a business.

Kamal Konveksi is a micro, small, and medium enterprise located in Janapria Village, Janapria District, Central Lombok Regency. This business is engaged in the manufacture of t-shirts using cotton combed 30s as raw material. In one-day business operation, Kamal Konveksi can produce between 200 and 300 pcs of finished products using 50 kg to 75 kg of cotton combed 30s raw materials. Every 1 kg of raw material can produce 3 pcs for L size, 4 pcs for M size, and 5 pcs for S size.

Kamal Konveksi often needs help with problems of excess and shortage of raw materials for cotton combed 30s fabrics in clothing production. This is because the supply or inventory of raw materials is only sometimes in line with production needs, and orders for raw materials cannot be produced at any time due to high expenditure costs and delivery waiting times. Therefore, Kamal Konveksi needs to control raw materials so that inventory can be appropriate and expenditure costs can be optimized.

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In this study, the method used the Economic Order Quantity (EOQ) and Period Order Quantity (POQ). The EOQ method was first developed by Fird Haris and RH Wilson in 1915 and considers ordering costs and inventory holding costs. The POQ method was used to determine the number of order periods using the same logic as EOQ. This study aims to optimize inventory control of fabric raw materials using the EOQ method as an alternative strategy for improving control planning. It is expected that this strategy can reduce expenses and minimize inventory problems that occur at Kamal Konveksi.

2. Literature Review

2.1. Inventory

Inventory is all goods or resources stored by an organization to meet demand, both internal and external. Goods included in inventory include raw materials, work in process, finished goods or final products, supporting materials, and other components used in production. Inventory has an important role in maintaining the company's smooth operation and minimizing costs. However, inventory can also cause cost and capital constraints. Therefore, it needs to be planned and controlled properly. Companies need to consider the optimal amount of inventory and reorder time, concerning customer satisfaction, suppliers, production planning, and human resources.

The main goal of inventory is to achieve an economical order quantity that results in minimal inventory costs, concerning the ordering costs and holding costs. In inventory control, it is necessary to establish policies that cover various aspects, such as ordering method, order quantity, order time, minimum inventory, inventory at reorder, and maximum inventory.

Inventory has a function as a buffer and link between production and distribution processes as well as a price stabilizer on the fluctuations in demand. Types of inventories include raw material inventories, purchased product or part inventories, auxiliary materials and supplies, semi-finished goods or work-in-progress inventories, and finished goods inventories. The costs arising from the existence of inventory include ordering costs, storage costs, inventory shortage costs, and excess inventory costs.

2.2. Inventory Control

Inventory control is an activity in a company's production operations that involves planning time, amount, quantity, and cost to maintain inventory according to the initial plan. Effective inventory control is a challenge because too much inventory can result in unproductive bonded funds, high storage costs, and the risk of damage to goods. On the other hand, too little inventory can cause stock-outs, stop production processes, and lose customers. The managerial function of inventory control is very important, because physical inventory is the largest investment in the company's current assets. Too much inventory causes excessive holding costs and potential "opportunity costs" that can be transferred to other, more profitable investments. On the other hand, inventory shortages can cause costs due to material shortages.

Inventory control aims to keep inventory at optimal levels to save expenses. These objectives include meeting consumer needs quickly, maintaining smooth production, increasing sales and company profits, avoiding small purchases that result in large ordering costs, and reducing excessive carrying costs.

The benefits of inventory control include improving customer relationships through timely delivery, maintaining smooth production, efficiency in purchasing, avoiding duplication of purchases, and efficient use of working capital. The inventory control methods that are commonly used include: Economic Order Quantity (EOQ) and Period Order Quantity (POQ).

2.3. Economic Order Quantity (EOQ)

Management needs to make two important decisions in inventory control: the amounts of materials or goods that must be ordered each time inventory is procured and when orders must be produced. Holding a lot of items will increase storage costs, while holding a few items can reduce storage costs, but increase ordering costs. One method that is often used in inventory control is the Economic Order Quantity (EOQ) method.

EOQ is a mathematical method used to determine the amount of goods that must be ordered to meet projected demand, with the aim of minimizing inventory costs. EOQ is the most economical purchase amount for each purchase. This method finds the answers to both important questions, namely how much to order and how long the time interval

between the first and subsequent orders results in minimal costs. In this case, EOQ refers to an effort from management, especially the supply and production department, to create balance and stability in various conditions. By applying the EOQ method, companies can achieve optimal conditions in inventory control.

The EOQ method, which was introduced by FW Harris in 1914, is a model that is widely used in inventory control techniques. Even though it has been around for a long time, the EOQ method keeps popular because of its ease of use although the assumptions used must be considered in its application.

$$\mathbf{EOQ} = \sqrt{\frac{2\,DS}{H}}$$

Information:

EOQ: Economic Order Quantity
D : Annual demand (Demand)
S : Ordering Cost
H : Storage cost (Carrying Cost)

Basically, the Economic Order Quantity (EOQ) method leads to the concept of economical purchases with a consistent amount each time an order is placed. Companies can determine the frequency of ordering raw materials in one year by dividing the total annual requirement by the number of purchases per order. The following is a formula that can be used to calculate order frequency:

$$\mathbf{f} = \frac{D}{EOQ}$$

Information:

f : Purchase frequency in one year
D : Total of raw materials demand for a year
EOQ: Economic Order Quantity

After obtaining the EOQ value and order frequency, the next step is to calculate the total inventory cost. This calculation aims to demonstrate that by using the optimal amount of raw material purchases, calculated using the EOQ method, a minimum total material inventory cost will be achieved. According to Heizer and Render, the total cost calculation can be done using the following formula:

$$\mathbf{TIC} = \frac{D}{Q}S + \frac{Q}{2}H$$

Information:

TIC : Total Cost
D : The number of requests in a certain period
Q : The optimal purchase quantity
S : Order fee
H : Storage fee

2.4. Period Order Quantity (POQ)

Period Order Quantity (POQ) is an alternative method of inventory control that is different from the Economic Order Quantity (EOQ). POQ is a method that regulates the number of orders periodically at certain time intervals, without considering the remaining inventory level. In the POQ method, the amount of inventory ordered each time an order is placed remains constant and is done periodically, for example every month or every week. In this case, the time interval between each order is fixed, but the amount of inventory ordered can vary depending on the demand level.

The POQ method concerns the ordering costs and holding costs to achieve a balance between these costs. By using this method, the company can avoid a bigger stockout risk.

he Period Order Quantity (POQ) calculation uses the following equation:

$$\mathbf{POQ} = \sqrt{\frac{2S}{DH}}$$

Information:

POQ : Period Order Quantity
S : Order fee each time when order (Rupiah/Unit)
H : Storage cost per unit
D : Material request

The next step is determining the most economical number of purchases for each order. How many raw materials must be ordered per order to minimize the total inventory cost. To calculate the amount or quantity of purchases in the Period Order Quantity (POQ) method, it can be used the formula as follows:

$$\mathbf{Q} = \frac{\mathrm{D}}{\mathrm{f}}$$

Information:

Q : Purchase quantity
D : Annual demand (Demand)
F : Order frequency

The calculation of the total cost can be done using the following equation:

$$\mathbf{TIC} = (\mathrm{f\ x\ S}) + (\frac{\mathrm{Q}}{2}\mathrm{H})$$

Information:

TIC : Total inventory cost
F : Order frequency
S : Order cost
Q : Order Quantity
H : Storage cost

2.5. Safety Stock

Safety stock is additional stock maintained to protect the possible stock-outs. Shortages can occur if the demand for goods during the ordering period exceeds the average daily requirement due to high demand each day or the ordering period needs to be shorter. If the company has excessive safety stock, storage costs will increase, but if the safety stock is too low, the company will face costs or losses due to material shortages. Therefore, companies need to determine the size of safety stock appropriately. According to Heizer and Render, the safety stock calculation uses the following equation:

$$\mathbf{SS} = (\text{Maximum Usage} - \text{Average Usage})\ \mathrm{X\ LT}$$

Information:

SS : Safety Stock
LT : Lead Time

2.6. Reorder Point

Reorder Point (ROP) is an inventory point when a company needs to place a reorder or new procurement to prevent inventory shortages. ROP is determined based on the average daily demand and lead time, that is the time taking from the time an order that is placed until the goods received. When inventory reaches or falls below ROP, the company must immediately take action to order or re-produce the item so that inventory keeps sufficient and stock shortages do not occur. By using ROP, companies can optimize their inventory, avoid stock-outs, and maintain smooth operations. The Reorder Point calculation uses the following equation:

$$\mathbf{ROP} = \mathrm{D\ X\ LT} + \mathrm{SS}$$

Information:

ROP : Reorder Point
D : Request
LT : Lead Time
SS : Safety Stock

3. Methods

3.1. Location and Time of Research

The research location was conducted at Kamal Konveksi, which is located in Janapria Village, Janapria District, Central Lombok Regency. Research time was carried out from January 2022 to December 2022 or until the data needed in the research is fulfilled.

3.2. Variable Identification

In this study, the relevant variables were identified. Here is a brief overview of the related variables:

- Dependent Variable

The dependent variable in this study is the total inventory cost. Total inventory costs include all costs incurred due to the number of requests in a year, lead time, storage costs, and ordering costs.

- Independent Variables

Independent variables are variables that affect changes in the dependent variable. In this study, independent variables include:

- Number of requests in a year: Represents the total demand for cotton combed 30s raw materials for one year.
- Lead time is the duration between ordering cotton combed 30s raw materials until they arrive at the company.
- Storage costs: These are costs incurred due to inventory storage, which can be expressed as a percentage of the average inventory value per year or in rupiah per year per unit of goods.
- Order costs: Represents all costs associated with the process of ordering goods, starting from the placement of orders to the availability of these goods.

3.3. Problem Solving Steps

At this stage, a brief description of the steps that was used to solve the problem. The following are the stages or steps in the research in order to solve the problems which are described through the flowchart on Figure 1.

4. Result and Discussions

4.1. Data Collection

Data collection was obtained by observing related companies from January 2022 to December 2022. From the observations, it is known that there are often excess and shortage of supplies. The following is data on the recapitulation of purchase and use of cotton combed 30s from January 2022 to December 2022, fabric purchase price data, order cost data, storage cost data, order frequency data, and average usage amount and lead time.

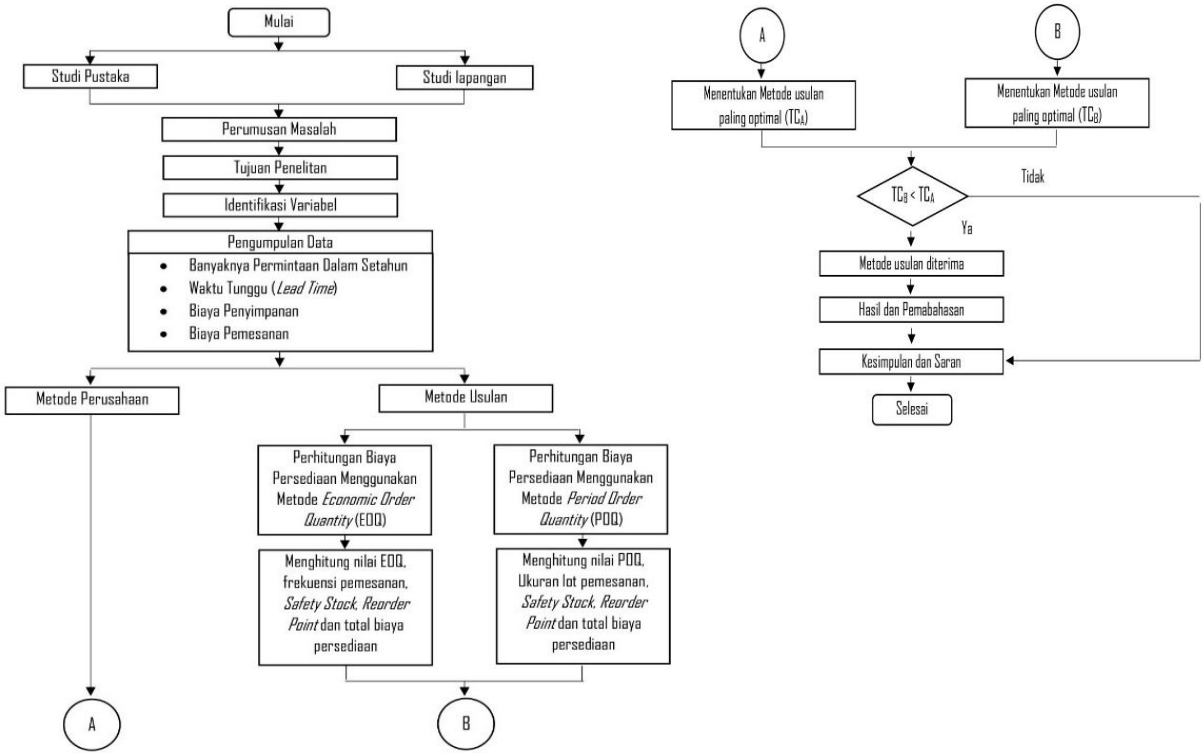

Figure 1. Flowchart

Table 1. Data on Purchasing and Using Cotton Combed 30s Fabrics

No.	Month	Purchase (kg)	Consumption (kg)	Total Purchase	Total Usage	Stock left	Canceled Order
1.	January	1.750	1.655	1.750	1.655	95	0
2.	February	1.700	1.646	3.450	3.301	149	0
3.	March	1.850	1.883	5.300	5.184	116	0
4.	April	2.100	2.177	7.400	7.361	39	238
5.	May	2.000	2.016	9.400	9.377	23	199
6.	June	1.900	1.834	11.300	11.211	89	0
7.	July	1.800	1.710	13.100	12.921	179	0
8.	August	1.700	1.723	14.800	14.644	156	0
9.	September	1.650	1.719	16.450	16.363	87	224
10.	October	1.800	1.762	18.250	18.125	125	0
11.	November	1.900	1.966	20150	20.091	59	207
12.	December	2.000	2.026	22.150	2.2117	33	218
Total				22.150	2.2117	33	1.086
Average				1.845,83	1.843,08	95,83	90,5

Source: Company Data

Table 2. Data on Purchase Price for Cotton Combed 30s Fabrics

No.	Raw material	Purchase Price/Kg
1.	Cotton combed 30s	Rp. 95.000

Source: Company Data

Table 3. Data on the Cost of Ordering Cotton Combed 30s Fabrics

No.	Raw material	Telephone Cost	Transportation Cost	Total Order Cost in One Order
1.	Cotton combed 30s	Rp. 30.000	Rp. 1.000.000	Rp. 1.030.000

Source: Company Data

Table 4. Data on the Storage Costs for Cotton Combed 30s Fabrics

No.	Raw material	% Save Cost	Price per Kg	Storage Fee per Kg
1.	Cotton combed 30s	4%	Rp. 95.000	Rp. 3.800

Source: Company Data

Table 5. Data on Order Frequency, Amount of Average Usage, and Lead time

Raw material	Order Frequency	Average Usage Amount	Lead Time (LT)
Cotton combed 30s	12 Times	1843 Kg	7 days

Source: Company Data

4.2. Data Processing

In the data processing stage, data processing and calculations are carried out for inventory control using the company method and the proposed method, namely the Economic Order Quantity (EOQ) and Period Order Quantity (POQ) methods.

1. Determining the Value of Safety Stock and Reorder Point

- Safety stock (SS) = (Maximum Usage - Average Usage) x LT
  = (2177 – 1843) x 7
  = 334 x 7
  = 2338 kg

- Level of requirement Per unit (d)

$$\frac{Annual\ Demand\ Quantity}{Number\ of\ Working\ Days\ per\ Year}$$

  = 22117/312
  = 70,887 kg/day

Thus, the total safety stock of cotton combed 30s that must be in Kamal Konveksi is 2338 kg.

- Reorder Points (ROP) = dx LT + SS
  = 70,887 x 7 + 2338
  = 2.834,21 kg
  = 2834 kg

It can be seen that Kamal Konveksi must reorder cloth raw materials when the supply of cloth raw materials in the warehouse remains 2.834 kg.

2. Calculation of Company Inventory Control

- TIC = (Average usage x H) + (S x F)
  = (1.843 x 3.800) + (1.030.000 x 12)
  = 7.003.400 + 12.360.000

= 19.363.400

Thus, the calculation of the total cost of supplying cotton combed 30s from January 2022 to December 2022 using the company's current method is Rp. 19.363.400

3. Calculation of Inventory Control by Economic Order Quantity (EOQ) Method

- *Economic Order Quantity* (EOQ)

$$= \sqrt{\frac{2\,DS}{H}}$$
$$= \sqrt{\frac{2 \times 22.117 \times 1.030.000}{3800}}$$
$$= \sqrt{11.989.742}$$
$$= 3.462{,}62$$
$$\approx 3.463 \text{ Kg}$$

The next step is to determine the order frequency. The Economic Order Quantity (EOQ) method refers to economical purchases of the same amount each time to place an order. The calculation of the order frequency used is as follows:

- Purchase frequency for a year (f)

$$= \frac{D}{EOQ}$$
$$= \frac{22.117}{3.463}$$
$$= 6.3$$
$$= 6 \text{ orders/year}$$

After obtaining the value of the EOQ and the frequency of orders, a calculation of the total cost of inventory is carried out which aims to prove that there is an optimal amount of raw material purchases. The calculation of the total inventory cost is as follows:

- TIC

$$= \frac{D}{Q} S + \frac{Q}{2} H$$
$$= \frac{22.117}{3.463} 1.030.000 + \frac{3.463}{2} 3.800$$
$$= 6.578.259 + 6.579.700$$
$$= 13.157.959$$

The total inventory cost incurred by Kamal Konveksi if calculated using the economic order quantity method is Rp. 13.157.959

4. Calculation of Inventory Control Period Order Quantity (POQ) Method

- Period Orders Quantity (POQ)

$$= \sqrt{\frac{2S}{DH}}$$
$$= \sqrt{\frac{2 \times 1.030.000}{22.117 \times 3.800}}$$
$$= \sqrt{\frac{2.060.000}{84.044.600}}$$
$$= \sqrt{0{,}0245}$$
$$= 0{,}157$$

From the calculation above, a POQ value of 0,157 is obtained, thus to determine the frequency of orders in a year is as follows:

- Order frequency for a year (f)

$$= \text{POQ} \times 12$$
$$= 0.157 \times 12$$
$$= 1{,}88$$

= 2 orders/year

The next step is to determine the most economical number of purchases to be made at each purchase. How many raw materials must be ordered at each order to minimize the total inventory cost. The calculation of the amount or quantity of period order quantity (POQ) purchases is as follows:

- Purchase quantity (Q) $= \frac{D}{f}$
$= \frac{22.117}{2}$
= 11.058,5
= 11.059 kg

The number or quantity of orders that must be ordered by Kamal Konveksi if calculated using the period order quantity method is 11.059 Kg.

After obtaining the value of the POQ and the frequency of orders, a total inventory cost calculation is carried out to prove that there is an optimal amount of raw material purchases. The calculation of the total inventory cost is as follows:

- TIC $= (f \times S) + (\frac{Q}{2} H)$
$= (2 \times 1.030.000) + (\frac{11.059}{2} x\ 3.800)$
= 2.060.000 + 21.012.100
= 23.072.100

Thus, the total inventory cost incurred by Kamal Konveksi if calculated using the Period Order Quantity method is Rp. 23.072.100

Based on the calculation results of the total cost of raw material inventory for cotton combed 30s that has been carried out, a comparison result is obtained between the calculation of raw material inventory according to the company's method and the results of calculating raw material inventory using the proposed method, namely Economic Order Quantity (EOQ) and Period Order Quantity (POQ). The comparison is presented in the following table:

Table 6. Data Comparison of the Total Cost of Inventory Company Method and the Proposed Method

Calculation		Number of Orders	Order Frequency	Total cost Supply
Enterprise Method		1.843 kg	12 times	Rp. 19.363.400
Proposed Method	EOQ	3.463 kg	6 times	Rp. 13.157.959
	POQ	11.059 kg	2 times	Rp. 23.072100

Source: Data Processing

Based on the analysis in Table 6, there is a comparison of the purchase quantity of cotton combed 30s raw material supplies and several different inventory control methods. In the proposed method, the average purchase quantity is 1.843 kg with a purchase frequency of 12 times in one year, resulting in a total inventory cost of Rp. 19.363.400.

In the Economic Order Quantity (EOQ) method, the purchase quantity for each order is 3.463 Kg with a purchase frequency of 6 times a year, resulting in a total inventory cost of Rp.13.157.959.

Meanwhile, in the Period Order Quantity (POQ) method, the purchase quantity for each order is 11.059 Kg with a purchase frequency of 2 times a year, resulting in a total inventory cost of Rp. 23.072.100.

Based on the results of these calculations, the Economic Order Quantity (EOQ) method indicates the most optimal purchase of cotton combed 30s raw materials to reduce raw material inventory costs. The total inventory cost difference between the EOQ and POQ methods is Rp. 9.914.141, while the difference with the company's method is Rp. 6.205.441

This study found that the inventory control system using the company's method could have been more optimal. Purchasing raw materials in small quantities and frequent ordering results in high ordering costs. On the other hand, the POQ method, which purchases raw materials in large quantities and infrequently, results in high storage costs.

Based on this analysis, the raw material inventory control for cotton combed 30s at Kamal Konveksi has yet to be effective. The Economic Order Quantity (EOQ) method is the most effective method for controlling raw material inventory. By using the EOQ method, companies can determine the optimal raw material inventory with a low total inventory cost. In addition, by implementing safety stock and reorder points, Kamal Konveksi can anticipate excess and shortage of fabric raw material supplies, resulting in the production process running smoothly without worrying about high inventory costs.

5. Conclusions

Data processing and analysis results indicate that inventory control for cotton combed 30s raw fabric materials at Kamal Convection can reach the most optimal point using the Economic Order Quantity (EOQ) method. In the EOQ method, companies are advised to purchase cotton combed 30s raw materials for each order of 3.463 kg with a purchase frequency of 6 times per year. By implementing the EOQ method, the company can save Rp. 6.205.441. In addition, to anticipate excess or shortage of fabric raw material inventory, Kamal Konveksi can set a safety stock of 2.338 kg and a reorder point of 2.834 kg. Therefore, using the EOQ method and implementing safety stock and reorder points will help Kamal Konveksi optimally control the supply of cotton combed 30s raw materials.

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