Manajemen Persediaan

SI403 Riset Operasi
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Mahasiswa mampu melakukan perencanaan untuk memastikan kelancaran operasi rantai pasok
Topik Bahasan

1. Manajemen persediaan dalam organisasi
2. Persediaan dan rantai pasok
3. Manajemen persediaan
Effective inventory management:
- important concern for managers in all types of businesses
- essential for realizing the full potential of any supply chain

The challenge → to have the right amount to achieve the competitive priorities of the business most efficiently AND not to pare inventories to the bone to reduce costs or to have plenty around to satisfy all demands

This type of efficiency can only happen if the right amount of inventory is flowing through the supply chain—through suppliers, the firm, warehouses or distribution centers, and customers
Much of inventory management involves **lot sizing** → the determination of how frequently and in what quantity to order inventory.

We make ample reference to the term **lot size** → the quantity of an inventory item management either buys from a supplier or manufactures using internal processes.
Manajemen persediaan dalam organisasi
Inventories are important to all types of organizations, their employees, and their supply chains affect everyday operations because they must be counted, paid for, used in operations, used to satisfy customers, and managed.

Inventories require an investment of funds, as does the purchase of a new machine; monies invested in inventory are not available for investment in other things; thus, they represent a drain on the cash flows of an organization.
Companies realize that the availability of products is a key selling point in markets.

**PROBLEM**

- too much inventory on hand reduces profitability,
- too little inventory on hand creates shortages in the supply chain and ultimately damages customer confidence

→ Inventory management involves trade-offs
Persediaan dan rantai pasok
The flow of materials determines inventory levels

- **Inventory** → a stock of materials used to satisfy customer demand or to support the production of services or goods
A **fundamental question** in supply chain management → **how much inventory to have**

The answer to this question involves a tradeoff between the advantages and disadvantages of holding inventory.

Depending on the situation, the pressures for having small inventories may or may not exceed the pressures for having large inventories.
An inventory manager’s job is to balance the advantages and disadvantages of both small and large inventories and find a happy medium between the two levels.

The primary reason for keeping inventories small is that inventory represents a temporary monetary investment. The firm incurs an opportunity cost, which we call the cost of capital, arising from the money tied up in inventory that could be used for other purposes.
The **inventory holding cost** (or carrying cost) → the sum of the cost of capital plus the variable costs of keeping items on hand, such as storage and handling costs and taxes, insurance, and shrinkage costs.

When these components change with inventory levels, so does the holding cost.

Companies usually state an item’s holding cost per period of time as a percent of its value.

The annual cost to maintain one unit in inventory typically ranges from 15 to 35 percent of its value.
Pressures related to maintaining large inventories:

1. **Customer Service** → A *stockout* is an order that cannot be satisfied, resulting in loss of the sale. A *backorder* is a customer order that cannot be filled when promised or demanded but is filled later.

2. **Ordering Cost** → The cost of preparing a purchase order for a supplier or a production order for manufacturing.

3. **Setup Cost** → The cost involved in changing over a machine or workspace to produce a different item.

4. **Labor and Equipment Utilization**

5. **Transportation Cost**

6. **Payments to Suppliers** → A *quantity discount* is a drop in the price per unit when an order is sufficiently large.
Inventory exists in three aggregate categories that are useful for accounting purposes.
1. **Raw materials** (RM) → the inventories needed for the production of services or goods; they are considered to be inputs to the transformation processes of the firm

2. **Work-in-process** (WIP) → consists of items, such as components or assemblies, needed to produce a final product in manufacturing; WIP is also present in some service operations, such as repair shops, restaurants, check-processing centers, and package delivery services

3. **Finished goods** (FG) in manufacturing plants, warehouses, and retail outlets → the items sold to the firm’s customers; the finished goods of one firm may actually be the raw materials for another
Another perspective on inventory is to classify it by how it is created.

In this context, inventory takes four forms:

1. cycle,
2. safety stock,
3. anticipation, and
4. pipeline.
1# **Cycle inventory**  →  the portion of total inventory that varies directly with lot size

**Lot sizing**  →  determining how frequently to order, and in what quantity. Two principles apply:

1. The lot size, \( Q \), varies directly with the elapsed time (or cycle) between orders. If a lot is ordered every 5 weeks, the average lot size must equal 5 weeks’ demand.

2. The longer the time between orders for a given item, the greater the cycle inventory must be.

\[
\text{Average cycle inventory} = \frac{Q + 0}{2} = \frac{Q}{2}
\]
2# Safety stock inventory → surplus inventory that protects against uncertainties in demand, lead time, and supply changes

To create safety stock:

- A firm places an order for delivery earlier than when the item is typically needed
- The replenishment order therefore arrives ahead of time, giving a cushion against uncertainty
3# **Anticipation inventory** → inventory used to absorb uneven rates of demand or supply, which businesses often face

4# **Pipeline inventory** → inventory that is created when an order for an item is issued but not yet received

- The average pipeline inventory between two stocking points can be measured as the average demand during lead time, \( D_L \), which is the average demand for the item per period (\( d \)) multiplied by the number of periods in the item’s lead time (\( L \)) to move between the two points, or

\[
\text{Pipeline inventory} = \overline{D}_L = \overline{d}L
\]
A plant makes monthly shipments of electric drills to a wholesaler in average lot sizes of 280 drills. The wholesaler’s average demand is 70 drills a week, and the lead time from the plant is 3 weeks. The wholesaler must pay for the inventory from the moment the plant makes a shipment. If the wholesaler is willing to increase its purchase quantity to 350 units, the plant will give priority to the wholesaler and guarantee a lead time of only 2 weeks.

What is the effect on the wholesaler’s cycle and pipeline inventories?
Pembahasan:

Kondisi saat ini

<table>
<thead>
<tr>
<th>Q</th>
<th>280</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle inventory = ( \frac{Q}{2} \times \frac{Q}{2} ) = 140 drills</td>
<td></td>
</tr>
</tbody>
</table>

| 2     |    2 |
| Pipeline inventory = \( dL \) = (70 drill/week) * (3 week) = 210 drills |

Kondisi diusulkan

<table>
<thead>
<tr>
<th>Q</th>
<th>350</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle inventory = ( \frac{Q}{2} \times \frac{Q}{2} ) = 175 drills</td>
<td></td>
</tr>
</tbody>
</table>

| 2     |    2 |
| Pipeline inventory = \( dL \) = (70 drill/week) * (2 week) = 140 drills |

→ Total biaya inventori yang diusulkan (175+140=315 drill) lebih rendah daripada saat ini (140+210=350 drill), ditambah waktu lead time yang lebih cepat yaitu 2 minggu
Inventory Reduction Tactics

**Cycle Inventory**
The primary lever to reduce cycle inventory → to reduce the lot sizes of items moving in the supply chain

**Safety Stock Inventory**
The primary lever → to place orders closer to the time when they must be received

**Anticipation Inventory**
The primary lever → to match demand rate with production rate

**Pipeline**
The primary lever → to reduce the lead time
Manajemen persediaan
ABC Analysis

A stock-keeping unit (SKU) → an individual item or product that has an identifying code and is held in inventory somewhere along the supply chain.

Thousands of SKUs are held in inventory by a typical organization, but only a small percentage of them deserve management’s closest attention and tightest control.

ABC analysis → the process of dividing SKUs into three classes according to their dollar usage so that managers can focus on items that have the highest dollar value.
This method is the equivalent of creating a Pareto chart except that it is applied to inventory

- Class A items → represent only about 20 percent of the SKUs but account for 80 percent of the dollar usage
- Class B items → account for another 30 percent of the SKUs but only 15 percent of the dollar usage
- Class C items → representing 50 percent of the SKUs with a mere 5 percent of the dollar usage

The goal of ABC analysis → to identify the class A SKUs so management can control their inventory levels
Class A SKUs
- Reviewed frequently to reduce the average lot size and to ensure timely deliveries from suppliers
- It is important to maintain high inventory turnover for these items

Class B SKUs
- Require an intermediate level of control
- Less frequent monitoring of suppliers coupled with adequate safety stocks can provide cost-effective coverage of demands

Class C SKUs
- Much looser control is appropriate
- A stockout of a class C SKU can be as crucial as for a class A SKU, the inventory holding cost of class C SKUs tends to be low
Inventory holding cost $\rightarrow$ the sum of the cost of capital and the variable costs of keeping items on hand, such as storage and handling, taxes, insurance, and shrinkage

Ordering cost $\rightarrow$ the cost of preparing a purchase order for a supplier or a production order for the shop

Setup cost $\rightarrow$ the cost of changing over a machine to produce a different item

Economic order quantity (EOQ) $\rightarrow$ the lot size that minimizes total annual cycle-inventory holding and ordering costs
The approach to determining the EOQ is based on the following assumptions:

1. The demand rate for the item is constant (for example, always 10 units per day) and known with certainty.
2. No constraints are placed (such as truck capacity or materials handling limitations) on the size of each lot.
3. The only two relevant costs are the inventory holding cost and the fixed cost per lot for ordering or setup.
4. Decisions for one item can be made independently of decisions for other items. In other words, no advantage is gained in combining several orders going to the same supplier.
5. The lead time is constant (e.g., always 14 days) and known with certainty. The amount received is exactly what was ordered and it arrives all at once rather than piecemeal.
Rumus menghitung total cost:

\[ C = \frac{Q}{2}(H) + \frac{D}{Q}(S) \]

- \( C \) = total annual cycle-inventory cost
- \( Q \) = lot size, in units
- \( H \) = cost of holding one unit in inventory for a year, often expressed as a percentage of the item’s value
- \( D \) = annual demand, in units per year
- \( S \) = cost of ordering or setting up one lot, in dollars per lot

Rumus menghitung EOQ:

\[ EOQ = \sqrt{\frac{2DS}{H}} \]
Sometimes, inventory policies are based on the time between replenishment orders, rather than on the number of units in the lot size.

The **time between orders** (TBO) for a particular lot size is the average elapsed time between receiving (or placing) replenishment orders of Q units.

\[
TBO_{EOQ} = \frac{EOQ}{D} \quad (12 \text{ months/year})
\]
A museum of natural history opened a gift shop two years ago. Managing inventories has become a problem. Low inventory turnover is squeezing profit margins and causing cash-flow problems. One of the top-selling SKUs in the container group at the museum’s gift shop is a bird feeder.

Sales are 18 units per week, and the supplier charges $60 per unit. The cost of placing an order with the supplier is $45. Annual holding cost is 25 percent of a feeder’s value, and the museum operates 52 weeks per year.

Management chose a 390-unit lot size so that new orders could be placed less frequently.

a) What is the annual cycle-inventory cost of the current policy?
b) Would a lot size of 468 be better?
Pembahasan:
D = (18 unit/mgu) * (52 mgu) = 936 unit
H = 25% * ($60/unit) = $15/unit
Q = 390 unit
S = $45
a) Total annual cycle-inventory cost saat ini:
\[
\begin{array}{ccc}
Q & D & 390 & 936 \\
C & = & \frac{(H)}{2} + \frac{(S)}{2} & = & \frac{($15)}{2} + \frac{($45)}{2} & = & $2.925 + $108 = $3.033 \\
\end{array}
\]

b) Total annual cycle-inventory cost alternatif (Q = 468 unit):
\[
\begin{array}{ccc}
Q & D & 468 & 936 \\
C & = & \frac{(H)}{2} + \frac{(S)}{2} & = & \frac{($15)}{2} + \frac{($45)}{2} & = & $3.510 + $90 = $3.600 \\
\end{array}
\]
→ Biaya total lebih tinggi daripada kondisi saat ini
For the bird feeder in Contoh #2

- a) Calculate the EOQ!
- b) How frequently will orders be placed if the EOQ is used?
Pembahasan:

D = (18 unit/mgu) * (52 mgu) = 936 unit
H = 25% * ($60/unit) = $15/unit
Q = 390 unit
S = $45

a) Economic order quantity (EOQ)

\[ EOQ = \sqrt{\frac{2DS}{H}} = 74,94 = 75 \text{ unit} \]

b) Time between order (TBO) untuk EOQ

\[ TBO_{EOQ} = \frac{EOQ}{D} = \frac{75}{936} = 0.080 \text{ year} \]
\[ TBO_{EOQ} = \frac{EOQ}{D} (12 \text{ months/year}) = \frac{75}{936} (12) = 0.96 \text{ month} \]
\[ TBO_{EOQ} = \frac{EOQ}{D} (52 \text{ weeks/year}) = \frac{75}{936} (52) = 4.17 \text{ weeks} \]
\[ TBO_{EOQ} = \frac{EOQ}{D} (365 \text{ days/year}) = \frac{75}{936} (365) = 29.25 \text{ days} \]
TUGAS #6:
LATIHAN MODEL PERSEDIAAN

»
Nelson’s Hardware Store stocks a 19.2 volt cordless drill that is a popular seller. Annual demand is 5,000 units, the ordering cost is $15, and the inventory holding cost is $4/unit/year.

- a) What is the economic order quantity?
- b) What is the total annual cost for this inventory item?
A regional distributor purchases discontinued appliances from various suppliers and then sells them on demand to retailers in the region. The distributor operates 5 days per week, 52 weeks per year. Only when it is open for business can orders be received. Management wants to reevaluate its current inventory policy, which calls for order quantities of 440 counter-top mixers.

The following data are estimated for the mixer:
- Average daily demand = 100 mixers
- Holding cost = $9.40/unit/year
- Ordering cost = $35/order

a) What is the total annual cost of the system?
b) Calculate the EOQ!
c) How frequently will orders be placed if the EOQ is used?
Terima Kasih