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Inventory Analysis

Key Learning Points

1. Describe the importance of managing inventory strategically.
2. Explain how to manage inventory.
3. Utilize inventory analysis in improvement projects.

What is Inventory?

Inventory is the stock of any item or resource used in an organization. Inventory normally includes raw materials, finished products, component parts, supplies, and work-in-process. The purpose of inventory is to manage the variation in product demand and balance economic purchase order size.

By managing the variation in demand, in delivery, and in the process, you can ease production scheduling, reduce the number of setups in a process, and balance future purchase order size.

Traditional View

In the traditional view of the cost of inventory there are:

- holding (or carrying) costs
- ordering costs
- shortage costs
- opportunity cost of capital (sometimes)

Lean View

In the lean view of the cost of inventory you reduce:

- wasted motion
- delay (Little's Law)
- slow discovery of quality issues
- disorder
- injuries and accidents

Little's Law

Little's Law is the relationship among work-in-process inventory, lead time, and throughput.

Little's Law was developed for queueing theory. John Little found that the long-term average number of customers in a queue is equal to the long-term average arrival rate multiplied by the average time each customer spends in the system. In a process, it means that work-in-process inventory is equal to lead time multiplied by units per time period.

We can reverse this to see how process lead time is affected by the amount of WIP inventory is in front of average orders.

$\text{WIP (units)} = \text{Lead Time} \times \text{Units per Time Period}$

$\text{Lead Time} = \text{WIP (units)} / \text{Units per Time Period}$

For example, if there are twenty orders in line to be processed, and we can fulfill four orders per hour, the lead time on an order is $20/4 = 5$ hours.

Strategic Inventories

There are two types of strategic inventories:

Safety Stock

Safety stock is maintained to mitigate the risk of outages due to uncertainties in supply and demand. Adequate safety stock levels allow an organization to proceed according to their plans, even when there are fluctuations in material supply or process yield.

An organization's safety stock compensates for (internal) process inefficiencies. A supermarket is an inventory that reduces the impact of those inefficiencies.

Buffer Stock

Buffer stock compensates for (external) customer demand fluctuations. This can be both WIP and finished goods inventory.

Buffer stock is often a system to buy and store inventory when materials are cheap

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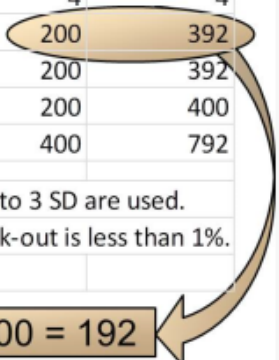

and plentiful to hedge against when costs go up and supplies go down.

Supermarket

When inventory is strategically placed and set with calculated minimum-maximum stocking levels to ensure optimum flow through the manufacturing process, this is known as a Supermarket.

In a Supermarket Minimum stocking levels should consider the average usage and usage during replenishment.

Safety stock provides additional margin to account for the variability of the production process, usually based on the standard deviation of usage.

Stocking a Supermarket for a Component		
	Average	Plus 2.4 SD*
Daily Use	50	98
Rational batch size	100	100
Replenishment time	4	4
Usage during replenishment	200	392
Minimum reorder point	200	392
Reorder quantity	200	400
Maximum possible on hand	400	792
* Standard Deviations. Typically 2 to 3 SD are used.		
At 2.4 SD, the probability of a stock-out is less than 1%.		
SD = 20 in this example		
<div>  </div>		
<div>  Safety Stock = 392 – 200 = 192 </div>		

History

In the 1950's Toyota sent teams to the United States to learn how mass-production is achieved. These teams first got inspiration for their new production system at a Piggly Wiggly, an American supermarket chain. They saw the way that this supermarket only reordered and restocked food once it was purchased and the shelf was cleared.

In a supermarket a customer buys what they need when they need it. Since the system is self-service the sales effort is reduced. The shelves are refilled as products are sold on the assumption that what has sold will sell again which makes it easy to see how much has been used and to avoid overstocking. The most important feature of a supermarket system is that stocking is triggered by actual demand.

Inventory Planning: ABC Analysis

The ABC principle is to “control the vital few.” An ABC analysis of inventory involves:

- Establishing levels of importance based on item characteristics, and

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classifying each item on the basis of the criteria established

- Applying a degree of control in proportion to the importance of the group

Inventory Accuracy

The first step in improving inventory accuracy is to measure the difference between actual counts and recorded counts.

The benefits of cycle counting is that there are more accurate inventory records, there is less over production, there are fewer stock outs, and inventory can be prioritized based on value.

Cycle Counting

Differences between actual counts and recorded counts can be costly to both the producer and the customer. Measuring this difference can be the first step in improving accuracy.

Cycle counting is the physical inventory taking task in which inventory is counted frequently rather than once or twice a year. Benefits of a more perpetual approach are:

- More accurate inventory records
- Less over production
- Less stock outs
- Can be prioritized based on value

Inventory Turnover

Companies analyze inventory turnover to normalize inventory value to sales or forecast. It is important to use comparable figures with a meaningful relationship to enable effective management decisions.

- Analysis can use either a rolling average or spot (single point in time) inventory.
- “Inventory Turns” are typically used (but not always) as a backward looking measure.
- “Weeks On-hand” typically measures current and future inventory.

Inventory Turnover Ratios

An inventory turnover ratio identifies relative measures of inventory investment.

$$\text{Inventory Turn} = \frac{\text{Annual Cost of Goods Sold}}{\text{Inventory Investment}}$$

$$\text{Weeks on Hand} = \frac{\text{Inventory Investment}}{\text{Weekly Cost of Goods Sold}}$$

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Turnover Example

Cost of Goods Sold (\$/1000)

Jul	Aug	Sep
6.2	6.8	7.2

Average Inventory Value for past 3 months = 20

$$\frac{(6.2 + 6.8 + 7.2) \times 4}{20} = 4.04 \text{ "turns"}$$

$$\frac{20}{(6.2 + 6.8 + 7.2) / 13} = 12.87 \text{ weeks on hand}$$

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When to Think About Inventory

Lean inventory management is an important consideration for most organizations. Benefits include:

- Increased inventory turns
- Less waste from expired, obsolete, or spoiled inventories
- Lower costs
- Faster operations
- Increased flexibility

Pitfalls to Avoid

- Using oversimplified models, especially ignoring seasonality
- Forecast bias
- Ignoring incentives – must balance service levels and inventory
- Misunderstanding the role of safety stock – necessary to manage variation
- Lack of inventory checks
- Lack of automation
- Lack of accountability