Operational decisions and stocks

Businesses purchase raw materials, semi-finished goods and components. A washing machine manufacturer, for example, may buy electric motors, circuit boards, rubber drive belts, nuts, bolts, sheet metal and a variety of metal and plastic components. These stocks of materials and components are used to produce products which are then sold to consumers and other businesses. Managing these materials is the responsibility of the production or operations manager. Materials management involves:

- the purchasing of stocks and their delivery;
- the storing and control of stocks;
- the issue and handling of stocks;
- the disposal of surpluses;
- the provision of information about stocks.

The nature of stocks

Businesses prefer to minimise stock holding because it is costly. In practice a variety of stocks are held, for different reasons.

**Raw materials and components** These are purchased from suppliers before production. They are stored by firms to cope with changes in production levels. Delays in production can be avoided if materials and components can be supplied from stores rather than waiting for a new delivery to arrive. Also, if a company is let down by suppliers it can use stocks to carry on production.

**Work-in-progress** These are partly finished goods. In a television assembly plant, WORK IN PROGRESS would be televisions on the assembly line, which are only partly built.

**Finished goods** The main reason for keeping finished goods is to cope with changes in demand and stock. If there is a sudden rise in demand, a firm can meet urgent orders by supplying customers from stock holdings. This avoids the need to step up production rates quickly.

Normally, at least once every year, a business will perform a STOCK TAKE. This involves recording the amount and value of stocks which the firm is holding. A stock take is also required for security reasons – to check that the items actually in stock match the stock records kept by the business. The stock take is also necessary to help determine the value of total purchases during the year for a firm’s accounts. A physical stock take can be done manually by identifying every item of stock on the premises. Many firms have details of stock levels recorded on computer.

The cost of holding stocks

In recent years stock management has become more important

---

Question 1.

(a) Look at the photographs. Explain which of them shows: (i) stocks of raw materials; (ii) work-in-progress; (iii) stocks of finished goods.

(b) Explain why businesses hold stocks of finished goods.
for many firms. Careful control of stock levels can improve business performance. Having too much stock may mean that money is tied up unproductively, but inadequate stock can lead to delays in production and late deliveries. Efficient stock control involves finding the right balance. One of the reasons why control is so important is because the costs of holding stocks can be very high.

- There may be an opportunity cost in holding stocks. Capital tied up in stocks earns no rewards. The money used to purchase stocks could have been put to other uses, such as buying new machinery. This might have earned the business money.
- Storage can also prove costly. Stocks of raw materials, components and finished goods occupy space in buildings. A firm may also have to pay heating, lighting and labour costs if, for example, a night watchman is employed to safeguard stores when the business is closed. Some products require very special storage conditions. Food items may need expensive refrigerated storage facilities. A firm may have to insure against fire, theft and other damages.
- Spoilage costs. The quality of some stock, for example perishable goods, may deteriorate over time. In addition, if some finished goods are held too long they may become outdated and difficult to sell.
- Administrative and financial costs. These include the cost of placing and processing orders, handling costs and the costs of failing to anticipate price increases.
- Out-of-stock costs. These are the costs of lost revenue, when sales are lost because customers cannot be supplied from stocks. There may also be a loss of goodwill if customers are let down.

Stock levels

One of the most important tasks in stock control is to maintain the right level of stocks. This involves keeping stock levels as low as possible, so that the costs of holding stocks are minimised. At the same time stocks must not be allowed to run out, so that production is halted and customers are let down. A number of factors influence stock levels.

- Demand. Sufficient stocks need to be kept to satisfy normal demand. Firms must also carry enough stock to cover growth in sales and unexpected demand. The term BUFFER STOCK is used to describe stock held for unforeseen rises in demand or breaks in supply.
- Some firms stockpile goods. For example, toy manufacturers build up stocks in the few months leading up to December ready for the Christmas period. Electricity generating stations build up stocks of coal in the summer. During the summer, demand for electricity is low so less coal is needed. At the same time, prices of coal during the summer months are lower, so savings can be made.
- The costs of stock holding. The costs of holding stock were described earlier. If stock is expensive to hold then only a small quantity will be held. Furniture retailers may keep low stock levels because the cost of stock is high and sales levels are uncertain.

- The amount of working capital available. A business that is short of working capital will not be able to purchase more stock, even if it is needed.
- The type of stock. Businesses can only hold small stocks of perishable products. The stock levels of cakes or bread will be very small. Almost the entire stock of finished goods will be sold in one day. The ‘life’ of stock, however, does not solely depend on its ‘perishability’. Stocks can become out of date when they are replaced by new models, for example.
- Lead time. This is the amount of time it takes for a stock purchase to be placed, received, inspected and made ready for use. The longer the lead time, the higher the minimum level of stock needed.
- External factors. Fear of future shortages may prompt firms to hold higher levels of raw materials in stock as a precaution.

Stock control

It is necessary to control the flow of stocks in the business. This ensures that firms hold the right amount. Several methods of stock control exist. They focus on the Re-order (EOQ) (how much stock is ordered when a new order is placed) and the Re-order level (the level of stock when an order is placed).

- Economic order quantity (EOQ). It is possible to calculate the level of stocks which minimises costs. This is called the economic order quantity. It takes into account the costs of holding stock, which rise with the amount of stock held, and the average costs of ordering stock, which fall as the size of the order is increased. A business must calculate the EOQ to balance these costs.
- Fixed re-order interval. Orders of various sizes are placed at fixed time intervals. This method ignores the economic
Stock control

order quantity, but ensures that stocks are 'topped up' on a regular basis. This method may result in fluctuating stock levels.

- **Fixed re-order level.** This method involves setting a fixed order level, perhaps using the EOQ. The order is then repeated at varying time intervals.

- **Two bin system.** This simple method involves dividing stock into two bins. When one bin is empty a new order is placed. When the order arrives it is placed into the first bin and stocks are used from the second bin. When the second bin is empty stocks are re-ordered again.

A stock control system is shown in Figure 1. It is assumed that:

- 50,000 units are used every two months (25,000 each month);
- the maximum stock level, above which stocks never rise, is 70,000 units;
- the minimum stock level, below which stocks should never fall, is 20,000 units, so there is a buffer against delays in delivery;
- stock is re-ordered when it reaches a level of 40,000 units (the re-order level);
- the re-order quantity is 50,000 units - the same quantity is used up every two months;
- the lead time is just under one month. This is the time between the order being placed and the date it arrives in stock.

This is a hypothetical model which would be the ideal for a business. In practice deliveries are sometimes late, so there is a delay in stocks arriving. Firms may also need to use their buffer stocks in this case. It is likely that re-order quantities will need to be reviewed from time to time. Suppliers might offer discounts for ordering larger quantities. The quantities of stocks used in each time period are unlikely to be constant. This might be because production levels fluctuate according to demand.

**Too much or too little stock**

Why might having too much or too little stock be bad business practice?

**Too much stock**

- Storage, insurance, lighting and handling costs will all be high if too much stock is held.
- Large stock levels will occupy space in the premises. There may be more productive ways of using this space, such as improving the layout of the factory.
- The opportunity cost will be high. Money tied up in stocks could be used to buy fixed assets, for example.
- Large stock levels might result in unsold stock. If there is an unexpected change in demand, the firm may be left with stocks that it cannot sell.
- Very large stocks might result in an increase in theft by employees. They may feel the business would not miss a small amount of stock relative to the total stock.

**Too little stock**

- The business may not be able to cope with unexpected increases in demand if its stocks are too low. This might result in lost customers if they are let down too often.
- If deliveries are delayed the firm may run out of stock and have to halt production. This might lead to idle labour and machinery while the firm waits for delivery.
- The firm is less able to cope with unexpected shortages of materials. Again, this could result in lost production.
- A firm which holds very low stocks may have to place more orders. This will raise total ordering costs. Also, it may be unable to take advantage of discounts for bulk buying.

---

**Question 2.**

Hahm & Odusanya is a machine fabrication specialist. It makes large parts for machine tools and special parts machines such as those found on production lines. It holds stocks of steel. The pattern of its stockholding is shown in Figure 2.

**Figure 2:**

![Graph showing stock levels](image)

(a) Measured in numbers of sheets of steel, what is (i) the maximum stock level; (ii) the buffer stock level; (iii) the re-order level?

(b) Explaining your reasoning, suggest in which weeks there was (i) an unexpected large rush order; (ii) very disappointing sales.

(c) Explain what might happen to maximum stock levels if the business began to experience cash flow problems.
Computerised stock control

Stock control has been improved by the use of computers. Many businesses hold details of their entire stock on computer databases. All additions to and issues from stocks are recorded and up to date stock levels can be found instantly. Actual levels of stock should be the same as shown on the computer printout. A prudent firm will carry out regular stock checks to identify differences.

Some systems are programmed to automatically order stock when the re-order level is reached. In some supermarkets, computerised checkout systems record every item of stock purchased by customers and automatically subtract items from total stock levels. The packaging on each item contains a bar code. When this is passed over a laser at the checkout, the sale is recorded by the system. This allows a store manager to check stock levels, total stock values and the store's takings at any time of the day. Again, the system can indicate when the re-order level is reached for any particular item of stock.

Access to stock levels is useful when manufacturers are dealing with large orders. The firm might need to find out whether there are enough materials in stock to complete the order. If this information is available, then the firm can give a more accurate delivery date.

JIT and stock rotation

In recent years many businesses have changed their approach to stock management. To reduce costs, firms have held low levels of stocks. In some cases holdings of both finished goods and raw materials have been reduced to zero. This approach to stock control is the key feature of just-in-time manufacturing (JIT). It is explained fully in the unit on lean production.

Businesses often use systems to control the flow of stocks in and out of their store areas. This flow of stock is sometimes called STOCK ROTATION. One system used to rotate stock is called First In First Out (FIFO). This means that those stocks which are delivered first are the first ones to be issued. This method is useful if stocks are perishable or if they are likely to become obsolete in the near future. A second method of stock rotation is called Last-In-First-Out (LIFO). This system involves issuing stock from the latest rather than the earliest deliveries. This method might be used if the stocks are difficult to handle and it is physically easier to issue the more recent deliveries. However, when using this method it is important that stocks are not perishable. 'Old' stock could remain in store for long periods before it is finally used.

**KEY TERMS**

- **Buffer stocks** – stocks held as a precaution to cope with unforeseen demand.
- **Lead time** – the time between the placing of the order and the delivery of goods.
- **Re-order level** – the level of stock when new orders are placed.
- **Re-order quantity** – the amount of stock ordered when an order is placed.
- **Stock rotation** – the flow of stock into and out of stores.
- **Stock take** – the process of counting the amount of stock held at a point in time in order to calculate the total stock level held.
- **Work-in-progress** – partly finished goods.

**KNOWLEDGE**

1. What are the activities involved in materials management?
2. Why do businesses prefer to minimise stock holdings?
3. What is meant by: (a) components; (b) finished goods?
4. What are the costs of holding stocks?
5. Why are buffer stocks held by firms?
6. Why do some firms stockpile?
7. What is meant by LIFO and FIFO?
Lean production

Lean production is a collective term for a series of Japanese-inspired measures designed to avoid waste in operations.

Chapter objectives

1. To explore the concept of waste.
2. To develop an understanding of lean production methods.
3. To contrast lean production with traditional production methods.

Waste and techniques that aim to eliminate it

Lean production is an integrated approach to design, technology, components and materials and requires a new culture for the firm. Elements of lean production include well-known techniques, such as just-in-time approaches to stock control, and less well-known techniques, such as time-based management and cell production. Before looking at these techniques in detail, it is worth exploring what is meant by a waste. Seven types of waste are identified by the Japanese proponents of lean production.

- **Waste from overproduction** Producing in excess of demand is clearly a waste of resources.

- **Waste of a waiting time** Work-in-progress that sits waiting for the next stage of the operation involves a waste in that, during the waiting time, value is not being added to the output. Lean production methods concentrate on maximizing the proportion of time used in value-adding activities.

- **Waste of transportation** Transporting goods from one part of the factory to another involves costs in terms of handling, and, again it is not adding value to the output.

- **Processing waste** Processing methods inevitably produce some waste, but lean production requires that this be kept to a minimum.
• **Inventory waste** Excessive stockholdings increase the cost of the product in terms of requiring extra handling, extra space, extra paperwork and extra interest charges.

• **Waste of motion** Movement does not necessarily mean that work is taking place. Movement that does not add value to the product should be kept to a minimum.

• **Waste from product defects** Product defects necessitate reworking or the scrapping of defective goods. This involves a waste of time and resources. Moreover, it increases the cost of warranties and places future business at risk.

Using traditional European or American methods (large-scale production, 'just-in-case' approach to stocks, long lead times and so on), these problems were disguised. However the adoption of lean production principles revealed them again. This can be seen in Figure 39.1, where the sources of waste are shown as boulders in water. At the high water level, the boulders are not visible, but are still present. A lowering of the water (stock level) reveals the problem and forces managers and employees to eliminate the problems. The emphasis is placed on:

- identification of problems;
- problem solving;
- improved utilization of people, space, capital and inventory.

This is done by the adoption of lean production techniques of:

- just-in-time production and stock-holding;
- time-based competition;
- cell working;
- flexibility in working methods;
- teamworking (see Chapter 43);
- continuous improvement, or Kaizen;
- quality circles;
- Total Quality Management (TQM) (see Chapter 37).

Before investigating each in detail, consider Table 39.1, which illustrates the differences between traditional and lean production methods.

**Just-in-time (JIT) Theory**

**JIT** involves both production and stock control systems in which work flows are scheduled so precisely that only the smallest amount of work-in-progress is held. This is made possible by
inputs from the previous stage in the production process arriving 'just in time'. These inputs from the previous stage might be from external sources or internal ones (in which case, the receiving department should be seen as the internal customer of the supplying department). JIT production reverses conventional approaches to manufacturing.

- 'First sell, then make it'. Production only takes place when there is actual customer demand for the output.
- Production is planned backwards instead of forwards.
- It is a pull rather than a push system of production. Each process 'pulls' more parts from the preceding processes(es) using a card or signal (known in Japanese as Kanban). The Kanban (card) is the means by which a customer (or succeeding operation) instructs a supplier (or preceding operation) to send more parts. Using two bins for a component, the empty one is wheeled out to the component production section with its Kanban order card. This triggers production of the component that must be completed just-in-time before the other bin runs out.

The requirements of successful JIT production are:

- employee flexibility;
- employee commitment;
- total quality or zero defects;
- preventive maintenance;
- cell production;
- continuous improvement to eliminate bottlenecks.

JIT purchasing from external suppliers involves the use of small, frequent deliveries rather than bulk contracts. This requires the close integration of suppliers with the company's manufacturing process. Features of the two purchasing systems are shown in Table 39.2.

The advantages claimed for JIT production and stockholdings are:

- the right quantities are purchased or produced at the right time;
- higher quality;
- improved customer service;
- minimization of inventory, work-in-progress and waste;
- reduced space requirements;
- reduction in manufacturing lead time;
- increased equipment utilization;
- simpler planning systems;
- increased workforce participation;
- continuous emphasis on improvement and problem solving;
- reduced costs.

There are also disadvantages or at least problems that have to be overcome for successful JIT working:

- it requires a high degree of delegation;
Table 39.2 Conventional and JIT purchasing

<table>
<thead>
<tr>
<th>Conventional purchasing</th>
<th>Just-in-time purchasing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large delivery lot sizes. Deliveries are infrequent</td>
<td>Small lot sizes, based on the immediate needs for production usage</td>
</tr>
<tr>
<td></td>
<td>Frequent delivery of stock</td>
</tr>
<tr>
<td>Deliveries are timed according to the buyer’s request date</td>
<td>Deliveries are synchronized with the buyer’s production schedule</td>
</tr>
<tr>
<td></td>
<td>Few suppliers are used for each part</td>
</tr>
<tr>
<td>Multiple sourcing is used to maintain adequate quality and competitive pricing</td>
<td></td>
</tr>
<tr>
<td>Inventories are maintained for parts</td>
<td>Little inventory is required because deliveries are expected to be made frequently, on time, and with high-quality parts</td>
</tr>
<tr>
<td>Purchasing agreements are set for the short term. Pressure suppliers by threatening to withdraw business</td>
<td>Purchasing agreements are long-term. Pressure suppliers, ensuring they feel obligated to perform</td>
</tr>
<tr>
<td>Products are designed with few constraints on the number of different purchased components used</td>
<td>Products are designed with great effort to use only currently purchased parts</td>
</tr>
<tr>
<td>Minimal exchange of information between supplier and buyer</td>
<td>There is extensive exchange of information with regard to production schedules, production processes, etc.,</td>
</tr>
<tr>
<td>Prices are established by suppliers</td>
<td>Buyer works with supplier to reduce supplier’s costs and, thereby, reduce prices</td>
</tr>
<tr>
<td>Geographic proximity of the supplier is not important for the supplier selection decision</td>
<td>Geographic proximity is considered very important.</td>
</tr>
</tbody>
</table>


- it requires a change in the philosophy and culture of the business;
- the advantages of bulk buying are lost;
- the business is vulnerable to a break in supply, including a breakdown in machinery;
- it does not work in the case of irregularly used parts or specially ordered materials;
- JIT purchasing requires reliable and flexible suppliers;
- it requires an atmosphere of close cooperation and mutual trust between the workforce and managers.