The weekly schedule will be adjusted for stock in plant. There are various models for calculating the reorder quantity for stock which takes into account various practical issues. For example, a manufacturer of screws would not be prepared to deliver one or even a handful of screws, the transportation costs would make it impractical. Similarly, there is a physical limits to how much can be transported in one lorry, and ordering a quantity that would require an additional lorry would dramatically affect the economics of the order.

Another issue is that it is very difficult to precisely identify the 'transaction' costs of reordering. How much does it cost a company to reorder? It is obviously difficult to separate out the time and effort each buyer spends on one order.

The problem is to balance the advantages of ordering large quantities infrequently and buying small quantities frequently. While we have stressed the disadvantages to a business of holding too much stock (buying large quantities infrequently), a business cannot afford to tie up key personnel in daily reordering. And, of course, if parts are not available, the business runs the risk of losing sales because it does not have products available when demanded. There has to be a balance between the two objectives.

One method to balance the two objectives is to use a calculation known as the **economic order quantity** (EOQ). This method takes into account the cost per order, the cost of each item of inventory, a carrying cost per year as a fraction of inventory value, demand during the year and an order quantity. This method obviously involves collecting a great deal of data, and making a number of assumptions or estimates. Computers are ideal for calculating such models and some large companies such as DEC have developed their own in-house variants of economic order quantity systems.

However, many companies are turning away from EOQ as being too cumbersome to administer in the fast-changing modern business world. EOQ and related systems are techniques, 'tools' for doing the job of reordering. Next, we look at another system which originated in Japan that takes a different approach to the reordering problem. It is known as just in time (JIT).

Q **ACTIVITY 8: QUESTION**

If a product has a long lead time, why will a business have to forecast its demand if it wants to ensure it always has the product in stock?

Identify some ways in which businesses can lose stock.

A **ACTIVITY 8: ANSWER**

If a product has a long lead time, it means that it either takes a long time to make or that some of its components have a long delivery time. In either case, estimates will need to be made about future demand. For example, because there is a long lead time on some television components, Toshiba will have to make forecasts of sales of televisions.

Businesses can lose stock through damage or obsolescence by, for example, damage in warehousing, spoiling of fresh ingredients, stockpiling components for products no longer in demand such as manual typewriters.

3.4 Just in Time

Japanese companies have achieved dominance in leading manufacturing industries, especially in the car and consumer electronics sectors. This success has been attributed to many reasons. Common to most suggestions has been that leading Japanese companies have concentrated on eliminating waste and making continuous improvements. Two general management philosophies underpin these efforts – **just-in-time** and **total quality management**. These are called philosophies rather than techniques because Japanese managers think organisations ought to make a commitment to these ideas as part of the way they are managed.

Just in time (JIT) is more than a logistical or inventory control technique, it is actually a manufacturing control philosophy. It has had a significant impact on the logistics function, which may seem to imply that JIT has features that can be adopted without taking on board the whole 'spirit' or philosophy of JIT. In fact, the JIT philosophy has major ramifications for the whole manufacturing process, and it requires a dramatic change from traditional relationships with suppliers. Here, we are only dealing with the issues relating to logistics. We are examining the implications of arranging for the delivery of goods and services 'just in time' to internal and external customers.

We can take the meaning of JIT at face value: it literally means producing goods exactly when they are needed – not before they are needed so that goods wait as inventory, nor after they are needed so that customers have to wait for goods. But this only looks at the time-based element of JIT. As an approach, JIT has more to offer. It seeks to eliminate all waste – in double handling, transportation, inspection and inventory.

The best way of understanding how a JIT approach differs from more traditional approaches to manufacturing control is to contrast two simplified manufacturing systems (see Figure 4).

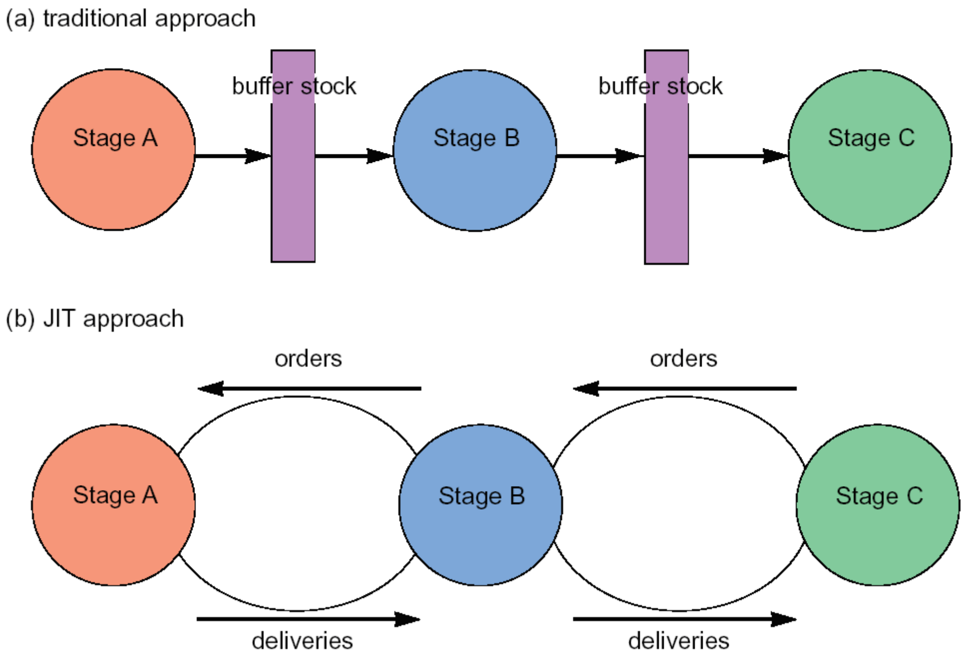

Figure 4: *Traditional and JIT approaches*

In the traditional system, inventory is held as a buffer between each stage of the manufacturing system, literally as insurance for when things go wrong. The advantage this gives is that the system can keep working even without fresh deliveries from the previous stage, it can use up its buffer stocks. However, this leads to high inventory costs, slower response to customer orders, loss of space, loss of control and, most critically, any problems are hidden.

In the JIT system, parts are produced and then passed directly to the next stage 'just in time' for them to be processed. Deliveries are only made when requested. Problems at any stage have a very different impact on this system. If stage A has a problem, stages B and C will immediately be affected, there is no buffer stock for them to continue work until the problem is resolved. One result of this is that a problem with one stage becomes everyone's problem – which increases the chances of the problem being solved as it is now affecting the whole work area.

By stopping inventory accumulating between stages, the operation has increased the chances of the plant becoming more effective. In JIT, a problem can stop all production; in traditional Western manufacturing systems, short-term 'remedies' would be put into place before the buffer stocks ran out, so that production would resume – until the same problem reoccurred. Two examples of problems that stop production are poor supplier quality and unreliable machinery.

JIT sees stock as a 'blanket of obscurity' which lies over the production system and prevents problems being noticed. This concept of inventory as obscuring problems is often presented metaphorically as a ship (the organisation) sailing over hidden rocks (the problems) protected by the sea (inventory) (Figure 5). Yet, even though the rocks cannot be seen, they slow the progress of the sea's flow and cause turbulence. Gradually reducing the depth of the water (inventory) exposes the worst of the problems which can then be resolved, after which more inventory is taken out, new rocks or problems emerge and are tackled.

Figure 5: *'Stock provides a blanket of obscurity'*

IMPLICATIONS OF JIT FOR LOGISTICS

JIT is a **pull system** that is, products are only pulled to the next link, machine or process by a specific demand. A contrasting system, which we don't cover in detail here, is material requirement planning (MRP), **a push system** whereby each link, machine or process pushes its products towards the next stage whether it is needed immediately or not.

What does this mean in practice? In a push system such as MRP, a stores person would deliver the output of stage A to stage B as soon as stage A had finished it. This allows the build up of the buffer stock in the traditional system. In a JIT system, nothing would be produced that is not required, so that the stores person would only deliver stock when stage B requested it. In JIT systems, these requests are called **kanbans**; the word is the name of the card used to indicate the request in Japanese. This system has the advantage of being very simple and easy to understand, coloured cards are often used.

As with all the features of JIT, its very simplicity is an asset as control is possible with eyesight instead of complicated (and expensive) computer software. There is a price to pay though, because JIT emphasises reducing waste and delivering just in time, it means that lots of deliveries of small quantities replace a few deliveries of large quantities.

This has implications for the logistics teams. For a large factory that has its suppliers delivering JIT, it means that the operation of receiving goods has to be very efficient, capable of turning around a delivery very quickly. As many more lorries will be received than under tradit ional methods, lorries are given 'time slots' which help reduce the level of inventory held to hours not days. Full-scale implementation of JIT sometimes requires suppliers to relocate their operations to be near to the customer company. This is very much the approach taken in Japan, where suppliers tend to locate in a cluster around a large manufacturing company. JIT operations, therefore, place enormous importance on material handling and packaging so that efforts can be minimised.

Q **REVIEW ACTIVITY 3: QUESTION**

At the end of Section 2 we looked at a case study about Honda's Swindon factory. Do you remember the shape of the site? Go back to Figure 3 and remind yourself of Honda's basic assembly plant layout. Honda, we know, practices JIT. Now, why do you think Honda wanted a rectangular shape for the main assembly area? Why has it got many delivery decks? Traditional delivery systems have one receiving deck. What advantages could there be for a JIT system in having lots of delivery decks? Describe how Honda is using just-in-time approaches and contrast this with how a traditional company would operate. (In other words, contrast JIT and more traditional techniques.)

A **REVIEW ACTIVITY 3: ANSWER**

A JIT approach requires lots of deliveries, but of small quantities, just when they are needed. The layout of Honda's plant facilitates deliveries to the exact point where they will be used in the factory. This minimises double handling. Traffic jams or congestion are avoided by the number of delivery points. In traditional sites, there would be chaos if many lorries turned up at the same time. The synchronisation of deliveries and production would break down.

With JIT no buffer stock is held, orders are delivered and then immediately used. With a traditional approach, a buffer stock is held. The holding of stock has implications for warehousing and stock control. Efficient receipt of many small orders is required with the minimum of checking and 'pieces of paper'. Honda relies on the supplier to supply in a sequence, at the required time and in the required place. A traditional approach would have deliveries shipped into the warehouse and then the internal distribution system would get the right components to the right place at the right time. Honda has to have a very close relationship with its suppliers as it is totally dependent on them. Honda avoids a lot of paperwork by videoing the deliveries and automatically implementing payment without needing delivery notes to be checked and invoices to be raised. The traditional approach has money tied up in stock.

Summary

Organisations face constraints in what material they can hold (supply) and in how accurately they can forecast what customers will buy (demand). Some face very long lead times and forecasting becomes critical. Materials planning and control perform this balancing act between trying to have enough, but not too much, stock. Computers are commonly used for materials requirement planning, and we have met briefly three systems, EOQ, MRP and JIT.

JIT is a philosophy which believes that activities that add no value are waste. It is a 'pull' not a 'push' system, inventory only being supplied when it is requested ('pulled') from the next step in the production process. This is in contrast to traditional systems which rely on buffer stock to overcome rather than solve problems. JIT highlights problems, involves much closer co-ordination and requires far closer relationships with suppliers.