Operations management techniques

The economic order quantity (EOQ)

Businesses use a number of quantitative techniques to make decisions about their purchases and stock levels. It is possible, for example, for a business to calculate the order size of its stocks, materials or components which minimises total costs. This is called the ECONOMIC ORDER QUANTITY. Total costs are made up of the costs of acquiring stock and the costs of holding stock. Acquisition costs include costs involved with the checking of vendor, negotiation, administration and the inspection of incoming goods.

Acquisition costs, holding costs and total costs are shown in Figure 4. Holding costs rise as order sizes get larger. Holding costs are zero when there are no orders. The larger the order size, the greater the costs of holding it in stock. Acquisition costs fall as order sizes get larger. For example, there is likely to be lower costs in negotiating a few large orders than constantly negotiating many small orders. The order size which minimises total costs will always be at the point where the acquisition cost and the holding cost curves cross each other. This is shown at point EOQ on the diagram.

**Figure 4: The economic order quantity**

![Graph showing the relationship between EOQ, acquisition costs, and holding costs](image)

**Question 3.**

Two warehouses W1 and W2 supply three retailers R1, R2 and R3. The supply capacity of the warehouses is 20 and 40 loads per week respectively. The demands of the retailers are 14, 20 and 26 loads per week respectively. The transport costs between the warehouses and retailers are summarised in Table 13.

<table>
<thead>
<tr>
<th>Warehouse</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>W2</td>
<td>4</td>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>

(a) Set up a transportation model by constructing a suitable matrix showing, costs, demands, and supply capacities.

(b) Determine the least cost solution for the distribution of loads from warehouses to retailers using your answer to (a) and calculate the cost. (Use trial and error)

The economic order quantity (Q) can be found using the formula:

$$Q = \sqrt{\frac{2CA}{HP}}$$

where C is the acquisition cost per order, A is the total number of units used each year, H is the holding costs as a percentage of the average stock value and P is the price of each unit.

The building contractor uses 5,000 bags of cement each year which cost £10 each. The holding cost of the cement is 5 per cent of average stock value and acquisition costs are £8. The economic order quantity for cement purchases will be:

$$Q = \sqrt{\frac{2 \times £8 \times 5,000}{0.05 \times £10}} = \sqrt{160,000} = 400 \text{ bags}$$

Thus, the builder will be minimising the total cost of ordering and holding cement if 400 bags are bought each time. In addition, it is possible to calculate the optimum number of
orders \( (A+Q) \) by transposing the above formula:

\[
\frac{A}{Q} = \sqrt{\frac{HPA}{2C}}
\]

\[
= \sqrt{\frac{0.05 \times £10 \times 5,000}{2 \times £8}}
\]

\[
= 12.5 \text{ orders per year}
\]

Limitations The assumptions on which the economic order quantity formula is based may be unrealistic in practice. The price of many materials, particularly commodities like oil, copper, coffee and cotton, tends to fluctuate with changing market conditions. Businesses are unlikely to have unlimited storage space. Materials, such as perishable goods, may deteriorate if left for a period of time. Changes in these assumptions may lead to different costs for a business, which might affect the EOQ. On the other hand, it could be argued that assumptions are not important, as long as a business realises the limitations and finds the predictions of the model useful.

**KEY TERMS**

- **Blending** - a graphical approach to linear programming which deals with resource allocation subject to constraints.
- **Cost-benefit analysis** - a technique which involves taking into account all social costs and benefits, when deciding on a course of action.
- **Economic order quantity (EOQ)** - the level of stock order which minimises ordering and stock holding costs.
- **Linear programming** - a technique which shows practical problems as a series of mathematical equations which can then be manipulated to find the optimum or best solution.
- **Simulation** - a technique which imitates what might happen in reality by using random numbers.
- **Transportation** - a method designed to solve problems where there are a number of different points of supply and demand, such as a number of manufacturers distributing their products to a number of different wholesalers.

**KNOWLEDGE**

1. State three situations where a simulation might be used.
2. Explain what is meant by:
   (a) private costs and private benefits;
   (b) external costs and external benefits.
3. 'The private costs of building a new motorway through a rural area are not the only costs that must be taken into consideration.' Briefly explain this statement.
4. Why are blending and transportation examples of linear programming?
5. Explain briefly two problems that businesses might have when using blending.
6. What does the use of blending show a business?
7. What types of problem does the transportation technique help to solve?
8. Why might a business want to calculate its economic order quantity?
9. State two problems with calculating the economic order quantity.