

Enterprise resource planning (ERP)

ERP is software that integrates management information from all business functions into a single IT-based system. It allows relevant information to be assessed and dealt with by the organisation, suppliers, customers and government so that costs and resources are minimised.

Main features of an ERP programme

An ERP system will be broken down into stand-alone or fully integrated modules, reflecting the functional areas such as marketing or finance. All the modules draw from and contribute to a central database, allowing shared information. Specialists supply off-the-shelf software or customised ERP systems. Without ERP the production department may not know details of orders or the finance department may be unaware of component costs. ERP deals with:

- supply chain management — ordering of raw materials and energy
- production — transforming inputs to output
- customer relation management — dealing with customers' enquiries, orders and delivery

Every business involved in production will be able to find out:

- what has been ordered
- how many components/raw materials of what type are needed
- whether raw material is in stock
- the progress of an order
- stocks available to meet orders
- whether payment has been requested or paid

The advantages of ERP are that it leads to lowered costs, greater communication and integration, lower inventory levels and quicker decisions. The disadvantages are that ERP systems are expensive and can take many months to become fully operational.

- 1 What do the initials ERP stand for?
- 2 State three benefits from introducing ERP.
- 3 State one disadvantage of introducing ERP.

How ERP can improve business efficiency

Better inventory control

Inventory is the raw materials, work in progress and finished goods held. ERP allows all areas to know precisely what inventory is held, what materials are needed for planned production and levels of unsold stocks. ERP matches incoming orders to unsold stock and/or plans the required production, including using or ordering raw materials or labour. The finance for these will automatically be released and customers informed about progress and delivery times.

More accurate costing and pricing

Because ERP contains information on all the resources needed for production, the exact cost of each order and unit is known, making setting a profit-making price easier. Prices can be varied to suit individual customers.

Higher capacity utilisation

Capacity utilisation (see below) is the proportion of full capacity currently being produced. The higher it is, the more efficient the business.

ERP tells the business exactly what orders are confirmed or possible, when they might have to be delivered and what resources are needed to meet them. This information allows as full a capacity as possible to be planned for, especially as finance can be planned into the process.

Faster responses to change

Any changes in orders, stocks, prices or availability of supplies or employees will be quickly picked up and decisions can be made on this information. Decisions will link all areas together in a planned, coherent way and enable flexible fast responses.

Better use of management information

ERP is the organisation of information in all business functional areas, enabling managers to take decisions based on the whole production process rather than individual isolated parts. This enables waste to be reduced.

Expert tip

ERP is only really effective if it is fully operational across all areas of business operation. It is not a magic answer to operations problems in every business.

Capacity utilisation

Capacity is the maximum output that can be produced using currently available resources. **Capacity utilisation** is the proportion of full capacity of a business unit currently being produced. It is important because operating at under or over maximum capacity results in higher costs and less efficient use of resources.

Measurement and significance of capacity

Maximum capacity is determined by the available resources of land, labour and capital. When these are being fully used, a business operates at full or maximum capacity. If there is spare capacity, resources will not be used but they might still incur costs, e.g. staff not working may still be paid, machines may attract interest payments. These fixed costs still have to be paid for. The lower capacity utilisation is, the higher the fixed cost per unit of output is, and it will be more difficult to make profits as the selling price will cover less of the fixed costs (lower contribution per unit to fixed costs and profit).

How capacity utilisation can be measured

Capacity utilisation is calculated by the formula:

$$\text{capacity utilisation} = \frac{\text{current output} \times 100}{\text{maximum possible output}}$$

Example

A factory can produce 1,600 units per day and is now producing 1,200. Capacity utilisation will be $1,200 \times 100/1600 = 75\%$

Implications of operating under maximum capacity

Operating under maximum capacity means there are unused resources that have to be paid for but do not contribute to generating an income.

Causes of under utilisation

- Falling demand, possibly due to a new competitor, a failure to achieve marketing targets or changes in consumers' tastes or incomes.
- Seasonal variations.
- Increasing capacity in the business.
- Inefficiency in production.

Capacity utilisation: the proportion of full capacity of a business unit currently being produced.

Table 1 Implications of under capacity operation

Positive implications	Negative implications
<ul style="list-style-type: none">● Ability to take and meet sudden large orders quickly.● Flexibility in production.	<ul style="list-style-type: none">● Higher unit fixed costs leading to pressure to increase prices.● Under or unemployed resources leading to poor motivation.● Unsold output leading to higher inventory costs.● Inefficiency in production leading to higher costs.

Implications of operating over maximum capacity

If demand is greater than full capacity, a business can take steps to increase production in the short term. This may mean:

- some customers are disappointed or receive late delivery
- quality may fall
- employees and managers may become stressed
- regular machinery maintenance may be difficult
- costs increase because of steps taken to increase production

- 5** A business has output in May of 400 units and maximum possible output per month of 600 units.
- (a) Calculate its capacity utilisation.
 - (b) Explain two reasons why the business might be operating at this level.
 - (c) Explain two reasons why the business might want to increase capacity utilisation to 90%.
- 6** Outline three ways a business might be able to increase capacity utilisation.

Increasing capacity utilisation

Operating at just below full capacity, e.g. 85–95%, is often seen as optimal as it lowers fixed cost per unit while retaining some flexibility to meet new orders, maintain equipment or train employees. Businesses must identify the reasons for under capacity operation. If it is market-related, a new marketing campaign to get more orders may be wise; if it is related to falling long-term sales, cutting capacity may be required.

Methods of improving capacity utilisation

Rationalisation and downsizing

Rationalisation is reorganising resources to increase efficiency and reduce capacity. It is often used when demand falls and is expected to remain lower. Three possible methods are:

- reducing labour force through redundancy, cutting working hours, stopping recruitment and/or redeploying staff to other jobs
- reducing the cost of assets by closing factories/offices and/or selling or leasing them
- selling, leasing or mothballing machinery and equipment

Increasing production

A business can start using underemployed or unemployed resources if extra orders arrive. There are other possibilities:

- adding labour by extra shifts or paying for overtime
- using zero hour contracts that only pay employees when they are actually working
- outsourcing or subcontracting work to other businesses that can deliver the right quality; this is often achieved by permanent arrangements with other businesses that can be called on when required

Outsourcing

Benefits of outsourcing

Outsourcing successfully requires careful checks on quality, reliability and prices. Assuming these are carried out the benefits may be:

- Access to specialised equipment and expertise, lowering costs.
- Enabling a focus on core activities, not worrying about those outsourced.
- Sharing risks with the other business.
- Lower operational, recruitment and overhead costs.
- Flexibility to bring in additional resources when required.

7 Explain why many businesses outsource some of their production.

Lean production and quality management

Lean production is an approach to production that stresses efficiency through the systematic examination of all processes to try and achieve quality with minimum waste. Quality management is how a business tries to achieve the quality that the customer wants.

These concepts apply to whatever production method a business uses.

Lean production

Lean production uses resources as efficiently as possible to achieve desired **quality** with minimum waste. It employs a range of techniques including kaizen, cell production, just-in-time, flexible specialisms and simultaneous engineering. Using these will produce:

- higher quality
- more employee involvement and motivation
- lower costs and lower waste
- greater efficiency
- improved cash flow

Expert tip

Lean production is not a method like batch or flow production. It is a set of techniques and attitudes that are applied in a business to make it more efficient.

Lean production requires an effective supply chain, trained and motivated employees and can reduce the opportunities for economies of scale and flexibility to meet sudden changes in demand.

Table 2 Lean production and links with production processes

Inventory control	Low inventory levels using just-in-time
Quality	Continuous quality assurance using total quality management
Employees' roles	Highly skilled, teamwork, flexible in roles, responsible for quality using cell production.
Capacity management	Flexible production when required to meet orders using flexible specialism and time-based management.
Efficiency	Lower costs, lower waste, planned movements of materials.

Cell production: a production technique that uses teams (cells) of employees who make their own decisions about the task they have to perform.

Lean production: a way of operating that uses resources as efficiently as possible to achieve desired quality with minimum waste.

Quality: the fitness for purpose as required by the customer in terms of design, reliability, level of faults and durability.

Methods of meeting customer demand more efficiently

- **Cell production** — Cell production is using teams (cells) of employees who make their own decisions about the task they have to perform. The cell is responsible for dealing with material/component orders, work rotas, quality

and use of equipment. This motivates employees, gives them control and enables better quality.

- **Time-based management (simultaneous engineering)** — Products are produced in response to consumer wants. New products have to be developed over time. This method arranges for development processes to occur at the same time whenever possible, rather than in a sequence. This enables a business to bring a new product to the market to meet consumers' demands to the market much more quickly.
- **Flexible specialism** — Flexibility in equipment and employees enables a basic product to be produced with a range of options. Cars can have different colours, engine sizes, internal features and wheels. Flexible specialism allows this to happen on a single minimum cost production line to the exact specification ordered by each customer.

Time-based management (simultaneous engineering): a system for enabling development processes to happen at the same time whenever possible, saving time in bringing a product to the market.

Flexible specialism: producing a basic product with a limited number of variations.

Kaizen in the context of lean production

Kaizen (continuous improvement) involves all workers being responsible for making improvements in production processes. It relies on workers taking on this responsibility and managers being prepared to allow them to do so. The changes are often on-going, regular and small but add up to significant large scale improvement. Kaizen is simple and cheap to implement. The regular small changes and the constant seeking for improvement lead to:

- improvements in productivity
- less waste
- a lower breakeven level of output
- more responsiveness to customer needs
- greater employee motivation and involvement

Costs of kaizen

- Training employees and managers in new attitudes.
- Setting up teams and empowering employees.
- Dealing with employees who do not want greater involvement.
- Making sure that all staff are involved.

Kaizen: continuous, regular, small improvements suggested by all employees as part of a culture of improvement.

Just-in-time (JIT) and its implications for lean production

Just-in-time (JIT) systems use as little inventory as possible. Raw materials are ordered as required for production, work in progress is minimised by only producing for firm orders and finished goods are despatched immediately. Production is 'pulled' through from the customer, not 'pushed' by the business producing goods that then have to be sold. The result is:

- low inventory holding costs and no overproduction
- time saved in moving supplies about
- less waste
- immediate delivery to customers
- improved quality and lower costs

Successful JIT depends on:

- reliable raw material suppliers on quick delivery time, quantity and quality
- accurate forecasts of customer demand
- a flexible workforce and reliable machinery
- enterprise resource planning (ERP) to integrate demand, production and suppliers

Just-in-time (JIT): JIT systems minimise inventory holding by producing goods to order using raw materials obtained for that purpose.

- 8 Define kaizen.
- 9 Identify two reasons why many businesses have implemented kaizen.
- 10 Give two requirements for a successful introduction of kaizen.

Quality control and quality assurance

Quality in terms of customer demands

There is no absolute quality measurement. A quality product is one that meets the requirement of the customer. This may be defined in terms of either a set of standards or specifications or in the sense of being 'fit for use' as a minimum standard. A cheap, throw-away razor will be less well made and durable than a more expensive, metal razor but each may be acceptable to the customer in terms of quality in relation to the price. This means it is vital to know what the customer is demanding and to produce this at minimum cost to the business. Any relevant legal requirements must also be met.

The importance of quality assurance

Quality assurance is a system for assuring customers that processes exist to maintain quality at every stage in production, including raw material supplies. It is often based on the idea that each production process acts as a supplier to an internal customer — the next stage. This means that faults are picked up during production and **quality control** is built into production. Waste is minimised as faults can be corrected at each stage, instead of having to throw away a finished product. Quality assurance is closely linked to kaizen and is essential for lean production. If quality assurance is not in place, businesses face waste, dissatisfied customers, lost orders and inefficient production.

Advantages of quality assurance

- Greater employee involvement and motivation.
- Lower costs as defects can be corrected as they occur (right first time).
- Employees are in the best position to detect and correct faults.

Disadvantages of quality assurance

- Greater demands on employees may reduce motivation.
- Conflicts with focus on levels of output.
- Cost of training and time for checking at each stage.
- Not all products need high standard of quality so time wasted.

ISO 9000 guarantees a documented quality assurance system and there are other government or industry awards for businesses that demonstrate quality assurance procedures.

11 Explain the difference between quality assurance and quality control.

Expert tip

Remember that: quality control is used to check quality, quality assurance involves setting up procedures to assure quality and TQM involves setting up a corporate culture of quality improvement.

Quality assurance: a system for assuring customers that processes exist to maintain quality at every stage in production.

Quality control: the methods used to check quality is assured, including inspection, testing random samples and involving the workforce.

Methods of quality control

Quality control is the methods used to check that quality is assured. These include inspection, testing random samples and involving the workforce.

Traditional quality control has focused on quality inspectors testing examples of the finished products to check they meet the quality standards. The examples are chosen at random and if faults are found more checks are carried out on the rest of the products.

Advantages of traditional end result quality control

- Experts check quality.
- Regular production problems can be highlighted and corrected.
- Faulty products are removed.

Disadvantages of traditional end result quality control

- Not every product is checked — method relies on statistical techniques.
- Negative for employees as the focus is on detecting faults.
- No responsibility on employees for quality so they are less likely to monitor their production.
- Waste results as faulty products are only found when finished.

Involving the workforce in quality control

Quality control need not be carried out at the end of production. It can be done at each stage by employees checking that they have met the quality standards involved in their task. This requires employees to be trained in quality standards and how to apply them. This kind of quality control is found in quality assurance or total quality management

Total quality management (TQM)

Aims and effectiveness of TQM

Deming set out **TQM** in the 1980s as a formal plan for quality assurance requiring commitment from the whole organisation and its employees to quality control in every task. This applies throughout the production process, from quality of raw materials to finished product. Its main points are:

- Get it right first time consistently.
- All staff must be committed to continuous improvement in quality.
- Build partnerships with suppliers.
- All staff are educated and trained in responsibility for quality.
- Supervisors should encourage, not find fault.
- Problem solving to be shared.
- Clear achievable goals for each employee and task.
- Workers to take pride in their work.
- An organisation structure and culture to support the above.

The potential of kaizen in TQM

TQM incorporates kaizen as a key part of its plan. TQM demands that all employees:

- are committed to continuous improvement
- share problem solving
- are educated and trained to take responsibility for quality

These are vital components of the kaizen approach to continuous improvement. Methods used to enact this include quality chains of internal supplier/customer relationships and quality circles where groups of employees meet to discuss quality improvement ideas.

Total quality management (TQM):

involves changing corporate culture so that all employees are involved in continuous quality improvement.

12 Define TQM.

13 Briefly explain the link between kaizen and TQM.

Benchmarking

Benchmarking is comparing a firm's procedures or products with the best practice in other businesses. The firm can then change its procedures or products to be at least as good as the best practice.

The importance of benchmarking in quality control

Successful benchmarking results in an improvement in quality. Being at least equal to the best will mean a business can present its products as market leaders and gain a reputation for reliability and quality.

Advantages of benchmarking

- By using information gained from observing other firms a business can improve quality.
- Best practice standards can lead to setting clear targets.
- Costs and waste can be reduced.

Disadvantages of benchmarking

- It is difficult to gain accurate information from other businesses.
- The temptation is to copy rather than build on best practice.
- The cost of collecting information may be more than any gains.

14 Define benchmarking.

15 Identify two advantages and two disadvantages of benchmarking.

Project management

A **project** is a particular business scheme with a specific objective, time scale and budget. It usually contains a number of activities and tasks that must be completed, some in a particular order. **Project management** deals with how resources are planned, organised and managed to complete the project successfully from start to finish in the set time allowed. Examples of projects include the building of a stadium or installing a new IT network. A-level project management focuses on managing time.

The need for projects and project management

Businesses operate at two levels. One is the day-to-day activities involved in finance, production, marketing and dealing with employees. The other is the way in which new activities for change are thought of, planned for and implemented. Many of these changes take the form of projects and need planning. Business environments are always changing, and projects are often a result of the need to react to change, e.g. prices change so a business decides it is worthwhile opening a factory in another country. This becomes a project.

Project failure

Project failure includes one or more of the following:

- The project is not completed at all.
- The project is not completed in the time allowed.
- The project costs more than the amount budgeted.
- Quality is not what was planned for.

Reasons for project failure

- Changes in the business environment, e.g. a ferry terminal baggage handling system has to be redesigned halfway through the project because two major new ferry routes are opened.
- Poor project management or interference by other managers.
- Weaknesses in the project management team.
- Cost overruns because prices rise unexpectedly.
- Loss of focus on the business benefits, e.g. a new building is designed well but not all its facilities are used.
- Warning signs on lateness or cost overruns are ignored.

Project: a series of activities with a defined beginning and end that are designed to achieve a particular objective.

Project management: planning, organising and managing resources to complete a project within a set time scale and budget.

16 Define project management.

17 State three reasons why a project may fail and give an example for each.

18 On a network diagram explain what is shown by the following:

- (a) a line
- (b) a circle
- (c) two parallel lines
- (d) an arrow

Network diagram: a diagram that identifies all the activities in a project, the time they take and the order in which they must be completed. The diagram is a key tool in network analysis or critical path analysis (CPA).

Activity: one of the specific tasks involved in completing a project.

Node: identifies the start and finish of an activity. Each is given an identifying number.

Earliest start time: the earliest possible time an activity can start after the beginning of the project.

Latest finishing time: the latest possible time an activity can finish without delaying the whole project.

Dummy activity: an activity that has a duration of zero and indicates when an activity cannot start until two other activities with the same starting and ending nodes have finished.

Minimum project duration: the shortest possible time in which a project can be completed.

Network diagrams

Network or critical path analysis (CPA) uses a **network diagram** of the activities needed to complete a project. The diagram shows the time taken for each activity and the order in which they must be completed.

Constructing a network diagram

To construct a network diagram, you need to:

- identify all the project activities and the time taken for each
- identify which activities must follow another and which can be done at the same time
- use this information to draw the network

Example

Building a studio art gallery

Activity	Length in days	Must follow
A Lay foundations and floor	10	
B Build walls	8	A
C Add roof	5	B
D Plaster walls and ceiling	1	C
E Install electrics	4	B
F Fit wooden doorframes	2	D
G Fit windows, door and paint	4	D
H Install hanging technology	6	D, E
I Fit outside fixtures	4	C

Some activities need to follow another, e.g. C must follow B. Some can be done at the same time as others, e.g. F, G, H and I can all be done at the same time.

Critical path: the sequence of activities that cannot be delayed without delaying the whole project.

Critical activities: activities that cannot be delayed without delaying the whole project.

Expert tip

Using critical path analysis can be time consuming. You must be able to draw and interpret network diagrams, complete them if there are missing elements and understand how critical path analysis is useful when carrying out a project.

Main elements of the network diagram

- **Activities:** are the tasks to be completed. Shown as a line with their duration and an arrow to show direction.
- **Nodes** identify the start and end of an activity. Nodes are shown as circles with **earliest start time (EST)** possible for the next activity and **latest finish time (LFT)** possible for the previous activity. The LFT shows the latest time an activity can be started without delaying the whole project.
- **Dummy activities** occur when an activity cannot start until two other activities have finished and these have the same starting and ending nodes. To avoid ambiguity, the dummy has a duration of zero and is shown as a dotted line.
- **Minimum project duration** is the shortest possible time in which a project can be completed.

Critical path analysis: drawing the network diagram

To draw up a network diagram you need to work from left to right:

- draw a start node
- draw activities as lines, each one starting and ending at a node.
- make sure that activities that require a completed previous one follow from the correct node
- check for any dummy activities and show as a dotted line
- show a finishing node to draw all activities to the conclusion

Using critical path analysis

- Work from left to right and enter the ESTs, taking the highest EST where there are two routes to a node.
- This will give the minimum project duration. Note that this is usually less than the total time for all the individual activities as some can be carried out simultaneously.
- Work from right to left and enter the latest finishing times, starting with the EST in the finishing node as the LFT at that point. Use the lowest LFT at each node.
- The **critical path** is the sequence of activities that cannot be delayed without delaying the whole project. The activities on this path are **critical activities** shown with two parallel lines on each critical activity.
- Critical path nodes and activities will have $EST = LFT$.

- 1 Enterprise resource planning.
- 2 Better inventory control lowers costs, more accurate knowledge of costs, higher capacity utilisation, faster response to change, more integrated information, less waste.
- 3 The time taken to implement it plus the cost of design, setting up and training.
- 4 Capacity utilisation is the proportion of full capacity of a business unit currently being produced.

$$\text{capacity utilisation} = \frac{\text{current output} \times 100\%}{\text{maximum possible output}}$$

- 5 (a) 67%
(b) Demand may have fallen; may be slack season; firm may have invested in production facility for the future.
(c) Lower fixed cost per unit; motivate employees; use inventory more efficiently.
- 6 Extra shifts for employees, more efficient ways of organising work to use equipment more, outsourcing some production and re-organising.
- 7 Allow specialists to produce; lower costs; more flexibility; share risks; gain access to skills outside the firm.
- 8 Kaizen is continuous regular small improvements suggested by all employees as part of a culture of improvement.
- 9 Simple and cheap to implement; generates efficiency ideas; motivates employees.
- 10 Training and teamwork — all staff must be involved, overcoming resistance.
- 11 *Quality assurance* is a system for making sure that processes are in place to maintain quality; *quality control* is the methods used to do this.

- 12 TQM involves changing corporate culture so that all employees are involved in continuous quality improvement so quality assurance is guaranteed.
- 13 Kaizen means every employee is continually involved in suggesting small improvements; TQM involves the whole workforce in reaching quality standards so kaizen enables quality to continually improve.
- 14 Benchmarking is comparing a firm's procedures or products with best practice in similar firms in order to identify and carry out possible improvements.
- 15 *Advantages*: quality improved where a company lags behind other firms; clear targets generated; costs reduced. *Disadvantages*: difficult to get accurate information from other businesses; expensive to collect information; may just copy not improve further.
- 16 Project management is planning, organising and managing resources to complete a project within a set time scale and budget.
- 17 A weak project management team who cannot control contractors and make workers keep to time; sudden unexpected price rises in materials or scarcity of skilled labour; change in the business environment, such as a new technological development, making the project outdated.
- 18 (a) line = activity
(b) circle = node
(c) two lines = critical path
(d) arrow = direction of activity

Building a studio art gallery

Figure 1 shows the network, ESTs, LFTs, a dummy activity and the critical path.

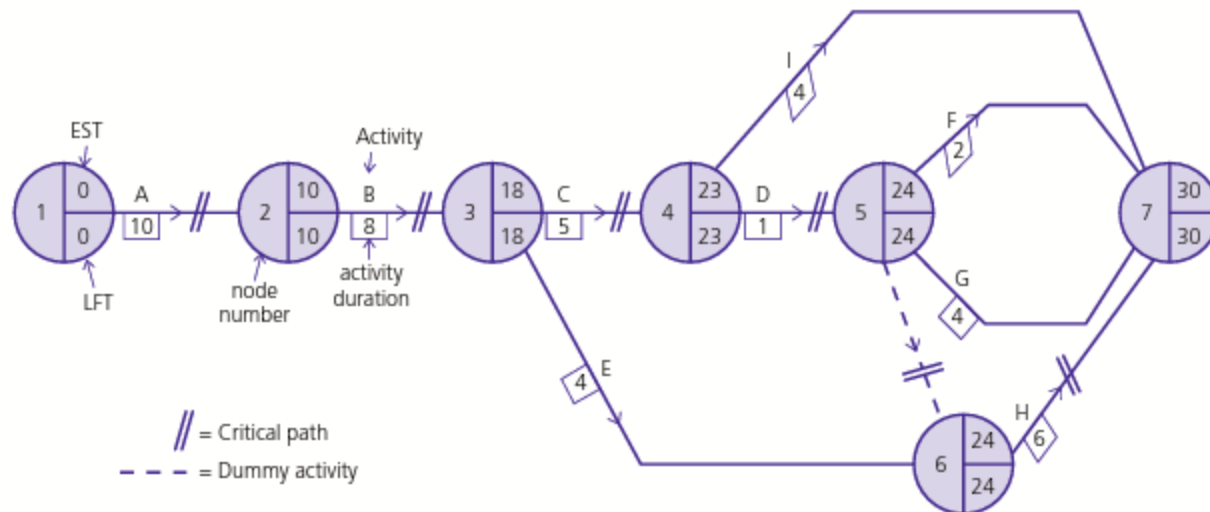


Figure 1 Network diagram: building a studio art gallery

Finding minimum project duration and critical path

- Minimum project duration is 30 days.
- Activities A, B, C, D, and H are critical activities.
- Activities E, F, G, and I are non-critical and can be delayed without delaying the whole project.
- Note that the critical path goes via the dummy activity.

Calculation of total and free float

- **Total float** and **free float** enable the calculation of how long an activity can be delayed before the next activity or the whole project is delayed.
- Total float is the maximum length of time an activity can be delayed without delaying the whole project = $LFT - duration - EST$.
- For activity E total float = $24 - 4 - 18 = 2$, meaning that E can be delayed for 2 days and the project will still finish in 30 days.
- Free float is the maximum length of time an activity can be delayed without delaying the next activity = $EST_{next\ activity} - duration - EST$.
- For activity E free float = $24 - 4 - 18 = 2$, meaning that activity E can be delayed for 2 days until day 20 because H must start on day 24.

Total float: the maximum length of time an activity can be delayed without delaying the whole project.

Free float: the maximum length of time an activity can be delayed without delaying the next activity.

CPA as a management tool

CPA enables planning of complex projects with an indication of the times by which activities must be completed and how important meeting those times is.

This enables efficiency and minimising costs. CPA can do the following:

- Calculate project duration, enabling deliveries for supplies and other resources to be planned.
- Show when activities are scheduled to happen, enabling resources to be available at exactly those times, prioritising the critical activities.
- Use EST and LFT to monitor progress and transfer resources from non-critical to critical activities if necessary to prevent lateness.
- Use total and free float to help decide which activities might need to be focused on. Those with high floats can spare resources for more critical activities.
- Decide which tasks can be carried out simultaneously.
- Indicate when there might be resource constraints, especially labour. It may be possible to carry out a number of activities at the same time but will there be enough resources to do this? CPA can show how to use a minimum of resources for the project.
- Be easily programmed into software packages to enable lean production and good supplier and customer relations.
- Use 'what if' analysis to judge the effect of different possible scenarios, e.g. the effect of taking more time for one activity.

Problems with CPA

- Relies on accurate data; this may not be available, especially as many projects are new.
- Encourages rigid thinking and does not guarantee success.
- Needs constant review, monitoring and management to be effective.
- Encourages focus on timing and speed rather than quality or flexibility.

Revision activity

An earthquake happens at 6.45 p.m. and a television company plans to feature the results on the 10 p.m. news. The producer draws up a list of the tasks that need to be done in order to make this possible.

Production tasks for earthquake report

Activity	Time taken minutes	Must follow
A Communicate with local broadcasters	15	
B Interview earthquake expert	20	
C Film and interview in earthquake area	60	A, B
D Emergency planning officer interviewed	20	C
E Studio review	30	C
F Prepare film	25	C
G Edit film	30	A, B, C, D, E, F

- 1 Draw a network diagram.
- 2 Identify the following:
 - (a) minimum project duration
 - (b) critical path
- 3 Calculate free float and total float for Activity D.
- 4 Will the television company be able to show its programme on the 10 p.m. news?
- 5 The emergency planning officer cannot be located at once, and his interview takes 45 minutes. How might the company still be able to show the programme on the 10 p.m. news?
- 6 Evaluate the usefulness of CPA to the television company.