

Operations management (5.1-5.9)

International Baccalaureate · IB Diploma · Business Management · HL

Operations management

IB Diploma Programme Business Management HL, Unit 5 *Operations management* (first assessment 2024). This topic covers sections 5.1 to 5.9: the role of operations, operations methods, lean production and quality (HL), location, break-even analysis, production planning (HL), crisis management (HL), research and development (HL) and management information systems (HL). The worked examples use the course's repair business, and the numbers fit Unit 3: each repair sells for 25 on average, uses 15 of parts and direct labour, and fixed costs are 12,500 a month.

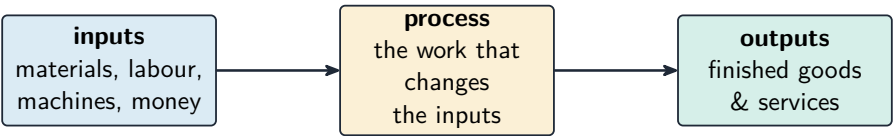
In March 2011 a huge earthquake and tsunami hit north-east Japan. Many of Toyota's suppliers stopped work. Toyota was famous for holding very little stock, so within days some of its factories in Japan and abroad had no parts, and output stayed low for months. Toyota did not give up its low-stock system. Instead it built a database of every supplier behind its suppliers, so it could act faster next time. This topic is about how a business makes its products, and the choices behind that: how much stock to hold, where to produce, and how to plan for things going wrong.

Must-know for this topic:

Idea	Key content
operations	inputs → process → outputs; links to finance, HR and marketing
methods	job, batch, mass/flow, mass customisation
lean and quality (HL)	kaizen, JIT, kanban, andon; cradle to cradle; quality control against quality assurance; TQM
location	reasons; outsourcing, offshoring, insourcing, reshoring
break-even	contribution 10; break-even 1,250 repairs; margin of safety 750
planning (HL)	JIT and JIC; reorder level 1,200; capacity 80%; defect rate 2.5%; make or buy
crisis, R&D, MIS (HL)	contingency planning; four types of innovation; data and ethics

The role of operations and operations methods

Operations management is the part of a business that makes its goods or provides its services. It turns **inputs** (labour, materials, machines, money and information) into **outputs** that are worth more than the inputs. The extra value is **value added**.



the output is worth more than the inputs ⇒ value added

Inputs are transformed into outputs worth more than the inputs: value added

Operations links to every other part of the business. Marketing says what customers want; finance pays for the machines; human resources finds the skilled staff. Operations must also be sustainable: a workshop that recycles oil and old tyres cuts its costs and its harm to the environment.

There are four main **operations methods** :

Method	What it is	Example	For and against
job production	one item made to a customer's order	restoring a classic car	high quality and high prices; slow, skilled staff, high cost per unit
batch production	a group of identical items, then a switch to the next group	servicing 40 taxis from one company in one week	some variety, lower cost; time is lost when switching between batches
mass production (flow)	the same item made without stopping	a car factory line	lowest cost per unit; expensive to set up, little choice, boring work
mass customisation	flow-line speed, but each customer chooses features	a car ordered online in your choice of colour and wheels	choice at a low cost; needs flexible machines and good data

Lean production and quality management (HL)

Lean production means using fewer resources, cutting waste and making the business more efficient. Waste includes making too much, waiting, moving things around, holding too much stock, and faulty work. The main methods are:

- **kaizen** : continuous improvement in many small steps. Every worker suggests better ways of doing the job.
- **just-in-time** (JIT): parts arrive just when they are needed, so almost no stock is held.
- **kanban** : a card or signal that tells the earlier stage to send more parts. When a box of brake pads is empty, its card goes back to the store and a new box comes.
- **andon** : a signal, often a light or a cord, that any worker can use to stop the line when there is a problem, so faults are fixed at once.

Cradle to cradle design plans products so that, at the end of their life, every part can be reused or recycled. Nothing becomes waste.

Quality means meeting customers' expectations. There are two approaches:

- **Quality control** checks the finished product and rejects faulty ones. It finds faults after they happen, so the work is wasted.
- **Quality assurance** builds quality into every stage, so faults do not happen in the first place. It is usually cheaper in the long run.

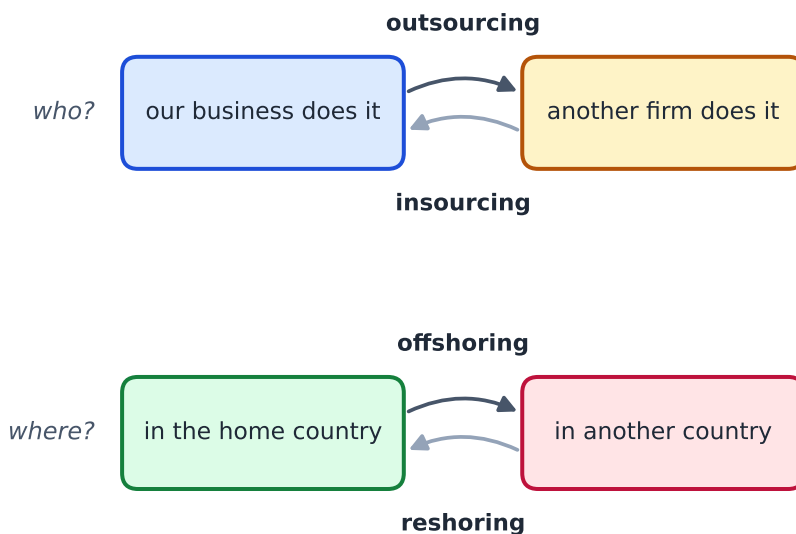
Ways to manage quality include **quality circles** (small groups of workers who meet to solve quality problems), **benchmarking** (comparing your methods with the best firm in the industry and copying what works), and **total quality management** (TQM), where everyone in the business is responsible for quality, all the time. Businesses can also meet national and international quality standards. ISO 9001 is the best-known international standard for quality management; in China, many products need the CCC mark before they can be sold. Standards build trust with customers, but meeting them takes time and money.

Location

Businesses choose a location by weighing:

- costs: land, rent, wages and transport;
- the labour available and its skills;
- nearness to customers (most important for services, such as repairs) and to suppliers (important for heavy materials);
- infrastructure: roads, ports, power and internet;
- government: taxes, grants, rules and political stability;
- culture and language, for a business moving abroad.

A business can also change who does the work and where.



Outsourcing and insourcing change who does the work; offshoring and reshoring change where

- **Outsourcing** (subcontracting) gives a task to another firm, such as the repair business paying a firm to run its booking app. It is often cheaper and uses the other firm's skills, but the business loses some control over quality.
- **Offshoring** moves work to another country, for lower costs or to be near new markets.
- **Insourcing** brings an outsourced task back inside the business, usually for better control or quality.
- **Reshoring** brings work back to the home country, often after supply problems abroad.

Break-even analysis

Contribution per unit is the price minus the variable cost per unit. It is the amount each sale adds towards paying the fixed costs.

$$\text{contribution per unit} = 25 - 15 = 10$$

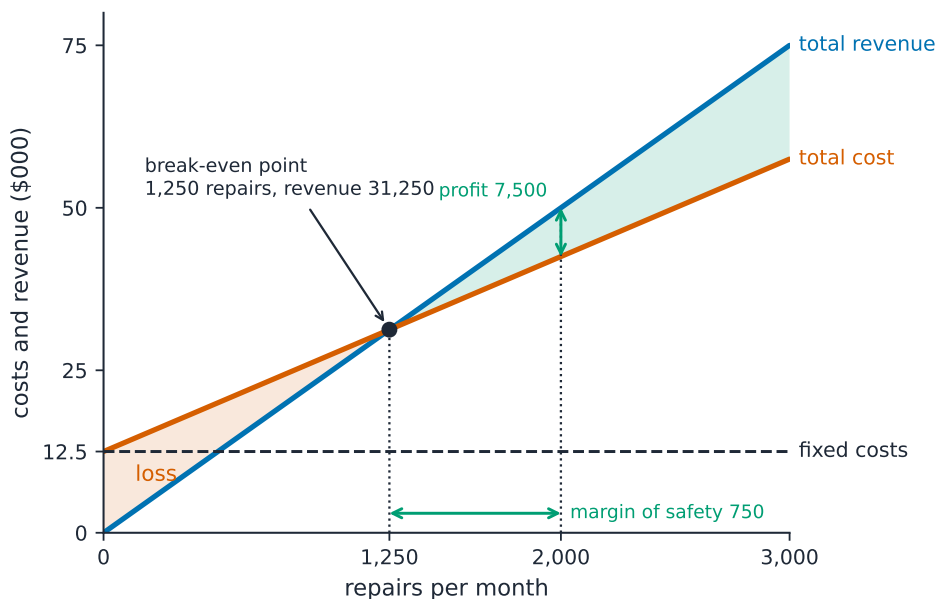
Total contribution is contribution per unit $\times$ output. At 2,000 repairs a month it is $2,000 \times 10 = 20,000$. Profit is total contribution minus fixed costs: $20,000 - 12,500 = 7,500$ a month.

The **break-even** output is where total revenue equals total cost, so there is no profit and no loss.

$$\text{break-even output} = \frac{\text{fixed costs}}{\text{contribution per unit}} = \frac{12,500}{10} = 1,250 \text{ repairs a month}$$

The **margin of safety** is how far sales can fall before the business makes a loss.

$$\text{margin of safety} = \text{actual output} - \text{break-even output} = 2,000 - 1,250 = 750 \text{ repairs}$$



Break-even at 1,250 repairs a month; at 2,000 repairs the margin of safety is 750 repairs

A business can also work out the output or price it needs for a **target profit** :

- $\text{target output} = \frac{\text{fixed costs} + \text{target profit}}{\text{contribution per unit}}$. For a profit of 15,000: $(12,500 + 15,000) \div 10 = 2,750$ repairs.
- $\text{target price} = \frac{\text{fixed costs} + \text{target profit}}{\text{output}} + \text{variable cost per unit}$. For a profit of 10,000 at 2,000 repairs: $(12,500 + 10,000) \div 2,000 + 15 = 26.25$.

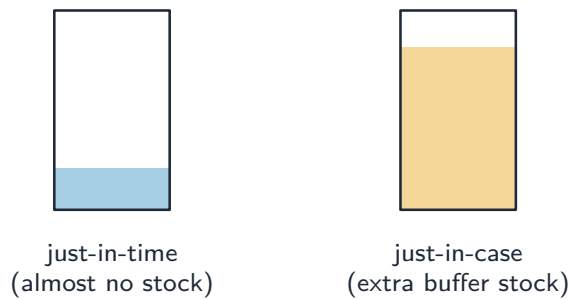
Worked example: a change in price and cost. The business raises its price to 27, so contribution rises to 12. In the same month the rent rises by 3,000, so fixed costs become 15,500. The new break-even output is $15,500 \div 12 = 1,291.7$, which rounds up to 1,292 repairs. If sales stay at 2,000, profit rises to $2,000 \times 12 - 15,500 = 8,500$, but the margin of safety falls from 750 to 708. If the higher price drives some customers away, the business is closer to a loss than before.

Break-even analysis is quick and easy to show on a chart, and it helps when planning prices or a new product. But it assumes that every unit made is sold, that the price and the variable cost per unit stay the same at every output, and that fixed costs never change. In real life, buying in bulk lowers variable costs, a bigger output may need a new workshop, and sales forecasts can be wrong.

Production planning (HL)

A **supply chain** is every step from raw materials to the final customer. A local supply chain is short and easier to control; a global one is often cheaper but longer, so there is more that can go wrong.

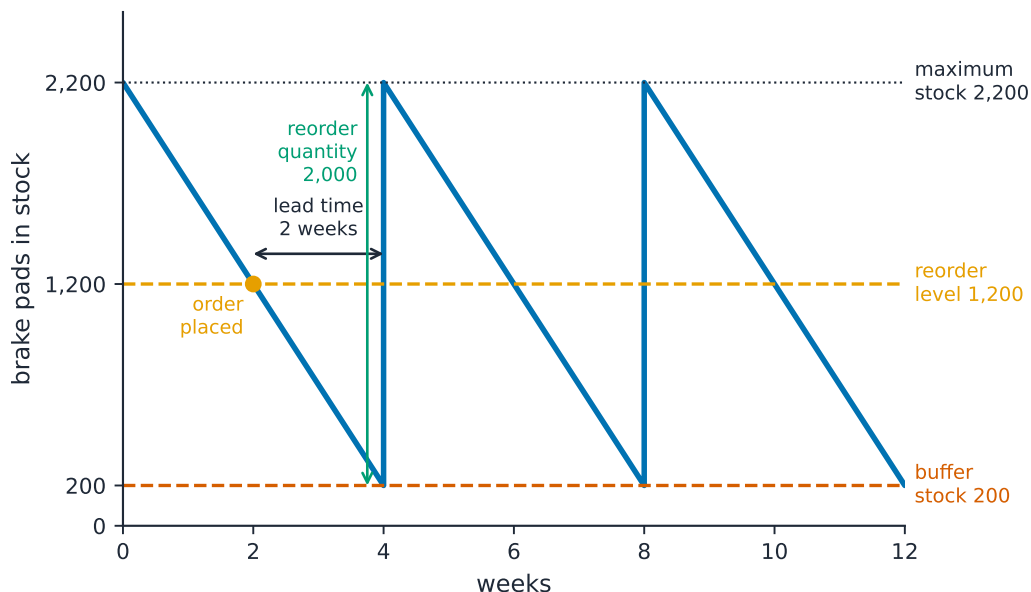
Businesses choose between two ways of holding stock. With just-in-time (JIT), parts arrive only when needed; this saves storage costs and money tied up in stock, but one late delivery can stop work. With **just-in-case** (JIC), the business keeps a large **buffer stock** for emergencies; this protects production but costs more to store, and stock can go out of date.



Just-in-time holds almost no stock; just-in-case holds a buffer

A **stock control chart** shows how stock falls as it is used and rises when a delivery arrives. The repair business uses 500 brake pads a week. A delivery takes 2 weeks to arrive (the **lead time**), and it keeps a buffer stock of 200.

- **Reorder level** = buffer stock + usage $\times$ lead time = $200 + 500 \times 2 = 1,200$. When stock falls to 1,200, the business orders more.
- **Reorder quantity** = the amount ordered each time, here 2,000.
- Maximum stock = buffer stock + reorder quantity = 2,200.



The order is placed at 1,200 and arrives two weeks later, just as stock reaches the buffer of 200

Operations managers measure their work with these ratios:

$$\text{capacity utilisation rate} = \frac{\text{actual output}}{\text{productive capacity}} \times 100 = \frac{2,000}{2,500} \times 100 = 80\%$$

Capacity utilisation compares what the business makes with the most it could make. A low rate means machines and staff stand idle and fixed costs are spread over few units. A rate near 100% leaves no time for maintenance or for a sudden rush of orders.

$$\text{defect rate} = \frac{\text{defective units}}{\text{total output}} \times 100 = \frac{50}{2,000} \times 100 = 2.5\%$$

The **defect rate** shows quality: here 50 repairs a month have to be done again.

- **Labour productivity** = total output ÷ total hours worked. The mechanics work 4,000 hours a month, so $2,000 \div 4,000 = 0.5$ repairs per hour.
- **Capital productivity** = total output ÷ capital input. With 20 car lifts, $2,000 \div 20 = 100$ repairs per lift a month.
- **Productivity rate** = output ÷ input × 100, used to compare one period with another.

Worked example: make or buy? The business uses 6,000 brake pads a year. A supplier sells them for 9 each. The business could make its own with a machine that costs 20,000 a year to run, plus 5 per pad for materials.

- **Cost to buy** (CTB) = price × quantity = 9 × 6,000 = 54,000.
- **Cost to make** (CTM) = fixed costs + variable cost per unit × quantity
= 20,000 + 5 × 6,000 = 50,000.

Making is 4,000 cheaper, but the business must also think about quality, the skills it would need, and whether 6,000 pads a year will stay the same.

Crisis management, R&D and information systems (HL)

■ Crisis management and contingency planning

A **crisis** is a sudden event that threatens the business: a fire, a data breach, a product that injures customers, or a supplier that closes. **Crisis management** is how the business responds while it is happening. Good crisis management needs:

- **transparency** : telling the truth about what happened;
- **communication** : keeping staff, customers, the media and the government informed;
- **speed** : acting quickly before rumours spread;
- **control** : a clear leader and a clear plan.

A **contingency plan** is written before a crisis. It lists the risks, who does what, and the backup options, such as a second supplier or a second workshop. Contingency planning costs time and money, and the crisis may never come. But it lowers the damage and helps the business recover faster, and it reassures insurers, banks and customers.

■ Research and development

Research and development (R&D) creates new products and new processes. It is expensive and slow, and many projects fail, but without it a business falls behind its rivals. There are four types of **innovation** :

Type	Meaning	Example
product	a new or improved product	a repair service for electric-car batteries
process	a new way of making or delivering the product	booking and paying through an app
positioning	a new image or use for an existing product	a sports drink first sold to people who were ill, later relaunched for athletes
paradigm	a deep change in how a whole industry works	ride-hailing apps changing how people get taxis

How much a business spends on R&D depends on how fast its industry changes (fast in phones, slow in furniture), on its culture (whether staff are encouraged to try new

ideas and allowed to fail), and on ethics (such as testing on animals or collecting users' data).

■ Management information systems

A **management information system** (MIS) collects data and turns it into information that managers use to make decisions. Some key terms:

Term	Meaning
data analytics	studying data to find patterns, such as which repairs are most profitable
database	an organised store of data, such as every customer's car and repair history
big data / data mining	very large sets of data; searching them for useful patterns
cloud computing	storing data and running software on remote servers over the internet
data centre	a building full of servers that store and process data
cybersecurity / cybercrime	protecting systems from attack; crimes such as hacking and stealing data
artificial intelligence (AI)	computers doing tasks that need human-like thinking, such as reading a fault from engine sounds
artificial neural network	a type of AI that learns from examples, loosely like a brain
Internet of Things (IoT)	everyday objects connected to the internet, such as a car that reports its own faults
virtual reality	a computer-made 3D world, used for training mechanics
customer loyalty programme	rewards for repeat customers, which also collect data on what they buy
digital Taylorism	using technology to measure and control every part of a worker's job
enterprise resource planning (ERP)	one system linking stock, finance, HR and sales

Term	Meaning
critical infrastructure	systems a country cannot work without, such as power, water and banking

Data helps a business decide faster and better, but it raises ethical questions. Customers should know what data is collected and agree to it; the data must be kept safe; and close digital monitoring of workers can harm their motivation and privacy.

Checklist

- The transformation process and value added; links between operations and the other functions; sustainability (5.1).
- Job, batch, mass and mass customisation, with an example and the advantages and disadvantages of each (5.2).
- HL: kaizen, JIT, kanban and andon; cradle to cradle; quality control against quality assurance; quality circles, benchmarking and TQM; ISO 9001 and national standards (5.3).
- Location factors; outsourcing, offshoring, insourcing and reshoring (5.4).
- Contribution 10, total contribution 20,000, break-even 1,250 repairs, margin of safety 750, target output 2,750 for a profit of 15,000, target price 26.25; the change to price 27 and rent +3,000 (break-even 1,292, margin 708); the limits of the model (5.5).
- HL: supply chains; JIT against JIC; reorder level 1,200, reorder quantity 2,000; capacity utilisation 80%; defect rate 2.5%; labour and capital productivity; CTB 54,000 against CTM 50,000 (5.6).
- HL: crisis management and contingency planning (5.7); R&D and the four types of innovation (5.8); the MIS terms and the ethics of data (5.9).

Paper 2 tests the calculations: write the formula, put in the numbers and give the answer with its unit, then say what it means for the business. Paper 1 asks about operations methods, quality and location in the case-study business. All numbers here are original.