

# Operations calculations

Operations managers need tools to track the performance of their departments. Quantitative tools are particularly useful for operations management. Businesses use a number of common performance indicators for operations including:

- productivity rate
- labour productivity
- capital productivity
- defect rate
- operating leverage
- capacity utilisation rate



**Figure 1.** Workers on the production line have their productivity measured.

Credit: alvarez, Getty Images

# Productivity

Productivity rate measures the average efficiency of production and is expressed as a ratio of output to inputs within the production process. Productivity rate is calculated using the following formula:

$$\text{Productivity rate} = \frac{\text{total output}}{\text{total input}} \times 100$$

Labour productivity measures the output per worker over a defined period of time (for example, per hour). It is calculated using the formula:

$$\text{Labour productivity} = \frac{\text{total output}}{\text{number of employees}}$$

For example, suppose a team of people is employed to proofread books for publication. If the team is made up of eight people and they can proofread 40 books per month, this would mean that labour productivity is five books per employee per month.

## Activity

**Learner profile:** Knowledgeable

**Approaches to learning:** Thinking skills (critical thinking)

Generally, businesses want to improve productivity because doing so lowers their costs of production and improves profits. Imagine that a hotel chain wants to improve productivity within its hotels.

In groups or alone, and using what you know from this Business Management course, identify and explain a few strategies that the business could use to improve productivity at the hotel. Your learning from [Unit 2 \(/study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/the-big-picture-id-39053\)](https://study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/the-big-picture-id-39053) on human resource management may be particularly helpful.

Capital productivity measures how efficiently a business utilises its capital (such as machinery or other fixed assets) to generate output. The higher the capital productivity rate, the more efficient a business is at utilising its fixed assets. For example, a drinks manufacturer has a factory that is capital intensive. The business will monitor the output of machines to establish how efficient the capital is.

To calculate capital productivity, a business uses the following formula:

$$\text{Capital productivity} = \frac{\text{total output}}{\text{capital input}}$$

For example, two machines may be capable of producing 50 000 drinks in one day. The calculation for capital productivity will be as follows:

$$= \frac{50\,000}{2}$$

$$= 25\,000 \text{ drinks per machine}$$



**Figure 2.** The higher the capital productivity rate, the more efficient a business is at utilising its fixed assets.

Credit: Sumith Nunkham, Getty Images

## Productivity and costs

Productivity is an important metric for business. The more productive labour and capital is, the lower the unit costs. The value of unit costs is measured using the following formula:

$$\text{Unit costs} = \frac{\text{total cost}}{\text{output}}$$

This calculation does not appear in the Business Management guide, but it is fundamental to understanding operations management, so it is worth taking the time to understand it. This is simply the average cost of making a *single* unit of output.

Lower unit costs improve profit margins because lower unit costs should reduce total costs, all other things being equal. If total revenue stays the same but total costs fall, then profit would increase and so would the profit margin (PM).

The relationship between productivity and costs can be seen in **Table 1**. Assume that a publishing business pays each staff member a salary of \$1000 per month. If each worker proofreads five books per month, the average cost would be \$200. If, through training, that worker can double productivity to 10 books per month, the average cost would be halved to \$100. If technology then helps increase productivity further to 20 books per month, the average cost would fall to \$50.

**Table 1.** The effect of increasing labour productivity on costs of production.

Output (books)	Salary or labour costs (\$ per worker)	Average cost (\$5 per book)
1	1000	1000
5	1000	200
10	1000	100
20	1000	50

## Defect rate

There is a risk that pushing workers and capital to produce more can cause more mistakes, called product defects. The defect rate is the percentage of output that does not meet expected quality standards. Quality control systems are discussed in Subtopic 5.3 (/study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/the-big-picture-id-39339). The defect rate is calculated using the following formula:

$$\text{Defect rate} = \frac{\text{defects}}{\text{output tested}} \times 100$$

For example, imagine that a toy business has 60 defects for every 1000 units it produces. The defect rate will be 6%. This may seem relatively small, but if even a small percentage of defective toys reach the market, this could cause a number of problems, such as:

- harm to customers caused by the defect itself
- the need to recall defective products, which is very expensive and lowers profits
- the undermining of confidence in all the products the business makes, harming sales revenues
- possible costly legal action if the business has been negligent



**Figure 3.** The pressure to increase productivity can lead to defects.

Credit: andresr, Getty Images

## Operating leverage

High levels of fixed costs relative to variable costs (and therefore total costs) make it more difficult for a business to break even. Thus, knowing the relative proportion of fixed costs in operations – called the operating leverage – can help a business to judge how difficult it may be to become economically sustainable. It can also help to predict how much any increase or decrease in sales revenues will affect profits.



High operating leverage means that the business spends relatively large sums on fixed costs such as research and development, physical capital or marketing. An example of an industry where operating leverage is high is the pharmaceutical industry. Businesses that produce medicines and vaccines must invest very large sums in research and development and in fixed capital, such as production plants. Large retailers, on the other hand, have a lower operating leverage. Global retailer Carrefour, for example, has relatively lower fixed costs and higher variable costs. This is because a large portion of its costs will be for the food and other consumer products that it sells in its stores. Operating leverage is calculated using the following formula:

$$\text{Operating leverage} = \frac{\text{quantity} \times (\text{price} - \text{variable cost per unit})}{\text{quantity} \times (\text{price} - \text{variable cost per unit}) - \text{fixed costs}}$$

In this formula, quantity is based on the number of goods sold. The price is the price at which each product is sold. A business will incur fixed costs, which it will need to pay regardless of whether it sells a small or large number of products. The variable cost will be dependent on how many items are sold.

For example, a biscuit manufacturer has fixed costs of \$800 000. The cost of production per packet of biscuits is \$0.04. Suppose that the business sells 1 000 000 packets of biscuits at a price of \$4 per packet. The following calculation can be made:

$$\text{Operating leverage} = \frac{(1\,000\,000 \times (4 - 0.04))}{(1\,000\,000 \times (4 - 0.04) - 800\,000)}$$

$$\text{Operating leverage} = \frac{(3\,960\,000)}{(3\,160\,000)}$$

$$\text{Operating leverage} = 1.25$$

This means that every 10% increase in sales will lead to a 25% increase in profits. This can be used to check potential changes in profit based on price and output changes. As fixed costs would be expected to remain the same, if prices change and/or number of units sold changes, then the changes in profit could also be calculated.

## Making connections

[Subtopic 5.5 \(/study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/the-big-picture-id-39338\)](/study/app/y12-business-management-a-hl-may-2024/sid-351-cid-174702/book/the-big-picture-id-39338) on break-even analysis is connected to operating leverage. The operating leverage ratio measures the ability of a business to cover costs and increase revenue. It can be used as a method for calculating the break-even point.

- Can you spot the concept of contribution per unit and total contribution in the formula for operating leverage? Try to simplify the formula to see what that reveals.

# Capacity utilisation

As businesses have fixed costs to pay, capacity utilisation is important. Capacity utilisation is the percentage of a company’s total capacity that is currently being used. When capacity utilisation rates are higher, the average fixed costs will fall because they will be divided by a larger output. The capital utilisation rate can be calculated using the following formula:

$$\text{Capacity utilisation rate} = \frac{\text{actual output}}{\text{productivity capacity}} \times 100$$

Capacity is the total output a company can produce using its current resources. If a clothing manufacturer can produce 1000 items per day, its daily capacity is 1000. Capacity utilisation is the percentage of the maximum potential output (capacity) that is currently being produced. If the same clothing manufacturer produces 800 units per day, then it is using 80% of its potential capacity.

If a hotel has 800 rooms but, on a given day, the number of rooms it fills is 300, then the capacity utilisation rate is just 37.5%. This may be an issue as staff salaries, utilities, rent, marketing costs and so on will still need to be paid. Service sector businesses such as airlines, restaurants, hotels, theme parks and sports and musical venues need to ensure that capacity utilisation is high to ensure that fixed costs are covered and average costs are lower.

**Table 2.** The effect of increasing labour productivity on costs of production.

Key Term	Short definition	Hotel example	Example as a number
Capacity	Maximum possible output.	The number of rooms available for booking.	800 rooms

<b>Output</b>	The current level of output at a point in time.	The number of room bookings.	300 rooms
<b>Spare capacity</b>	Potential additional output that is not currently being realised.	The number of empty rooms.	500 rooms
<b>Capacity utilisation</b>	The percentage of potential output that is currently being used.	The percentage of rooms booked by guests.	37.5%

High capacity utilisation means that a company is using its resources efficiently. This should reduce average costs and hopefully increase profits. This is important, for example, for hotels operating within large cities where fixed costs (such as rents and salaries) are often much higher. These city-based hotels would need to ensure that they are full so that the fixed costs can be spread across the higher output, reducing the average cost per unit as a result.

The downside of a company having an extremely high capacity utilisation rate is that workers and/or machines will be working flat out. This can raise stress levels of staff and leave little time for maintenance, either of which can lead to a drop in quality. In the context of a hotel, this could mean that there is a lot of pressure on staff to clean rooms, provide services to guests and ensure high levels of customer service are maintained. It could also mean that customers may not be able to book rooms, which they could find frustrating. If a business is regularly operating at an extremely high capacity utilisation rate, this may be an indication to the business that they need to expand, adding additional capacity.

## Activity

**Learner profile:** Knowledgeable

**Approaches to learning:** Thinking skills (transfer)

1. Use the figures in the table to calculate the various factors listed for Company A.



Factor	Figures	Final answer
<b>Defect rate</b>	Number of defective products: 1500 Total number of products tested: 4000	
<b>Labour productivity</b>	Total output: 12 000 Number of employees: 21	
<b>Operating leverage</b>	Total output: 12 000 Price per unit: \$2000 Variable cost per unit: \$1000 Fixed costs: \$2 000 000	
<b>Capacity utilisation</b>	Total output: 12 000 units Potential output 16 000 units	
<b>Capital productivity</b>	Total output: 12 000 Capital input: 150 000	

2. Comment on what these calculations may suggest. Here is some additional information to compare against.

- Industry average defect rate: 20%
- Average labour productivity in the industry: 370 units per worker
- Industry average operating leverage: 1.3
- Average capacity utilisation rates (1 year): 87%
- Previous year's capital input: 0.15

## Exam tip

You should always use the following rule when asked to calculate anything:

**Formula → Figures → Final answer**

If you display the correct working but fail to get the correct final answer, you will still receive marks.

Note that you must remember units (such as \$) or quantity produced, as you could be penalised for failure to write the correct unit of measurement.