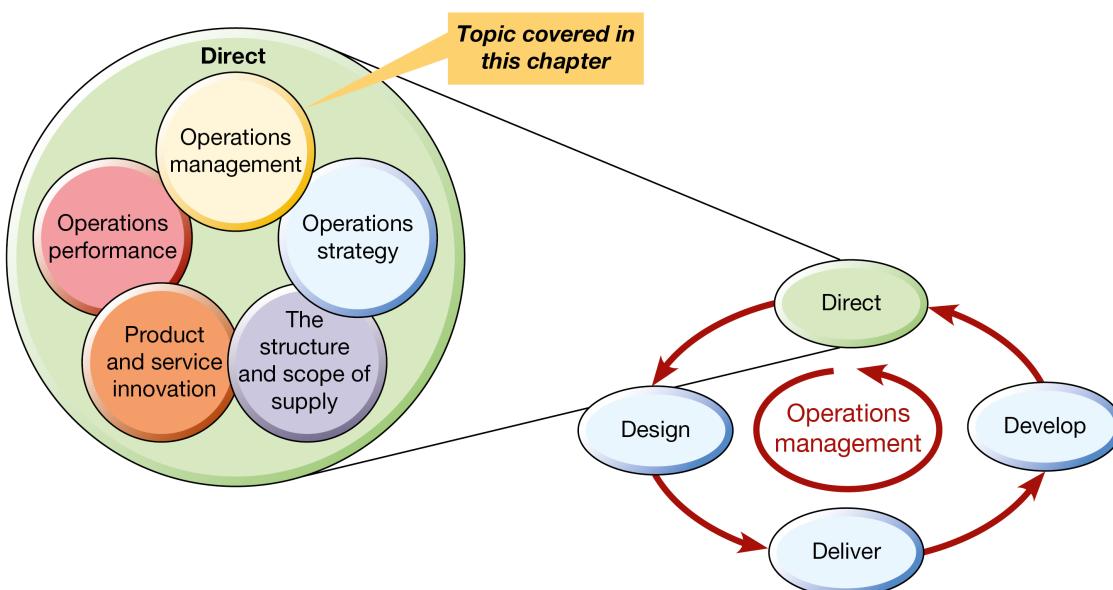


Chapter 1 Operations management

Introduction

Operations management is about how organisations create and deliver services and products. Everything you wear, eat, sit on, use, read or knock about on the sports field comes to you courtesy of the operations managers who organised its creation and delivery. Everything you look up on a search engine, every treatment you receive at the hospital, every service you expect in the shops and every lecture you attend at university – all have been created by operations managers. While the people who supervised their creation and delivery may not always be called ‘operations managers’, that is what they really are. And that is what *Operations Management* is concerned with – the tasks, issues and decisions of those operations managers who have made the services and products on which we all depend. This is an introductory chapter, so we will examine what we mean by ‘operations management’, how operations processes can be found everywhere, how they are all similar yet different, and what it is that operations managers do (see **Figure 1.1**).

Figure 1.1 This chapter examines operations management



The figure depicts the role operations management plays through a series of shapes and arrows as follows. To the right are four ovals with arrows running counter clockwise connecting each oval to form a circle. These four ovals are labelled direct, design, deliver, and develop. Inside of the circle that is

formed, it is labelled Operations management with a counter clockwise arrow circling the label. On the left the figure shows a large circle labelled direct. Inside of that circle are five circles labelled operations management, operations performance product and service innovation, the structure and scope of supply, and operations strategy. The operations management circle has a comment box indicating that it is the topic covered in this chapter. The large circle, labelled direct, has a line drawn around it which attaches to the direct oval on the operations management cycle to the left of the circle. The line that circles the large direct circle and loops to the direct oval is portrayed as a pulley system.

Learning Objectives

- 1.1 Recall the purpose of operations within an organisation.
- 1.2 Recognise the importance of operations management in different types of organisation.
- 1.3 Identify the stages of the input-transformation-output process.
- 1.4 Define the process hierarchy.
- 1.5 Use the 4Vs model to compare operations.
- 1.6 Outline the role of the Operations Manager using an example.
- 1.7 Apply key concepts of operations management to a case study.

1.1 What is operations management?

1.1 Recall the purpose of operations within an organisation.

Operations management is the activity of managing the resources that create and deliver services and products. The operations function is the part of the organisation that is responsible for this activity.

Every organisation has an operations function because every organisation creates some type of service and/or product. However, not all types of organisation will necessarily call the operations function by this name. (Note in addition that we also use the shorter terms ‘the operation’ or ‘operations’ interchangeably with the operations function.) Operations managers are the people who have particular responsibility for managing some, or all, of the resources that comprise the operations function. Again, in some organisations, the operations manager could be called by some other name. For example, they might be called the ‘fleet manager’ in a distribution company, the ‘administrative manager’ in a hospital, or the ‘store manager’ in a supermarket.

Operations principle: All organisations have ‘operations’ that produce some mix of services and products.

We will start by looking at examples of operations in practice at LEGOLAND® and LEGO®, on the next screen.

Operations in practice: LEGOLAND® and LEGO®

LEGOLAND® and LEGO®

They may seem to be very different businesses, even though they partly share the same name.

LEGOLAND is a world-renowned chain of location-based family leisure theme parks, and LEGO is one of the best-known makers of learning toys. But look in more detail and they share many common operations management activities. It is by looking at these activities that we can understand some of the similarities and difference between operations.

LEGOLAND¹

Theme parks are a multi-billion-dollar industry. And one of the best-known brands in the industry is LEGOLAND®, whose LEGO-themed attractions hotels and accommodation are aimed primarily at families with children aged 3 to 12. LEGOLAND has parks in seven countries and across three continents. The first park opened over 60 years ago, near the LEGO factory in Billund, Denmark. Location is important. For example, LEGOLAND Deutschland is located in Bavaria close to Switzerland and Austria, all markets with a significant Lego following. All LEGOLAND parks are operated by the UK-based Merlin Entertainments, which also operates other branded attractions in the United Kingdom, Italy and Germany, such as Madame Tussauds, The London Eye, Warwick Castle and Alton Towers. What all of these have in common is that they provide their visitors with an ‘experience’. In 2021, LEGOLAND Windsor opened LEGO Mythica, a new experience for visitors, as described by LEGOLAND divisional director Helen Bull, in this video.

Every stage of each attraction that customers (usually referred to as ‘guests’) move through has to be designed to create an intense or immersive experience centred on theming around movie or television characters, or in the case of LEGOLAND, LEGO intellectual property. The individual attractions in theme parks require considerable investment, often using sophisticated technology. Maintaining the utilisation of these attractions means trying to manage the flow of guests around the park so that they are queueing for as little time as possible. However, public holidays, seasons and weather will all impact on the number of guests wanting to visit each park. But however busy a park is, the quality of its guests’ satisfaction with the experience is an important part of LEGOLAND’S operations management. What it calls its ‘Guest Obsession’ with creating smooth and memorable experiences for its guests includes

regularly monitoring guest satisfaction scores and using ‘net promoter’ measurement (we will learn about this measurement in **Chapter 2**).

LEGO²

The LEGO Group, a privately held, family-owned company, with headquarters in Billund, Denmark, is one of the leading manufacturers of play materials. LEGO bricks are manufactured at the Group’s factories, located to be near its key markets in Europe and the United States, as explained by LEGO’s executive chairman and former chief executive, Jorgen Vig Knudstorp, in this video.

The company’s success is founded on a deceptively simple idea. One LEGO brick is unremarkable, but put one or two or more together and possibilities start to emerge. For example, there are more than 915 million possible ways of arranging six standard four-by-two bricks.³ With all the elements, colours and decorations in the LEGO range, the total number of combinations becomes very large indeed. Yet however many bricks you assemble, and irrespective of what colour or set they are from, they will always fit together perfectly because they are made to very high levels of precision and quality. The company’s motto is ‘Only the best is good enough’. At the Billund operation, 60 tons of plastic is processed every 24 hours, with its moulding machines supplied by a complex arrangement of tubes. This stage is particularly important, because every LEGO piece must be made with tolerances as small as 10 micrometres. The moulds used by these machines are expensive, and each element requires its own mould. Robot trolleys travel between the machines, picking up boxes and leaving empty ones, an investment in automation that means that few people are required. In the packaging process the LEGO sets take their final form. The system knows exactly how much each packed box should weigh at any stage and any deviation sets off an alarm. Quality assurance staff perform frequent inspections and tests to make sure the toys are robust and safe. For every 1 million LEGO elements, only about 18 (that’s 0.00002 per cent) fail to pass the tests. In addition, throughout the process, the company tries to achieve high levels of environmental sustainability. Plastic is extensively recycled in the factory.

Operations management is central to both businesses

Both LEGOLAND, which provides an entertainment service, and LEGO, which manufactures the famous LEGO bricks, depend on their operations managers to survive and prosper. It is they who design the stages that add value to the guests or how the plastic flows through the operation. They manage the activities that create services and products, they support the people whose skill and efforts contribute to

adding value for both customers and the business itself. They attempt to match the operation's capacity with the demand placed upon it. They control quality throughout all the operation's processes. And they make whatever strategy each organisation has into practical reality. Without effective operations management, neither business would be as successful. Of course, there are differences between the two operations. One 'transforms' their guests, the other 'transforms' plastic. Yet they share a common set of operations management tasks and activities, even if the methods used to accomplish the tasks are different.

Operations in the organisation

The example of LEGOLAND and LEGO illustrates how important the operations function is for any company whose reputation depends on creating high-quality, sustainable and profitable products and services. Their operations and their offerings are innovative, they focus very much on customer satisfaction, they invest in the development of their staff, and they play a positive role in fulfilling their social and environmental responsibilities. All of these issues are (or should be) high on the agenda of any operations manager in any operation.

Continuing this idea, **Table 1.1** shows just some of the activities of the operations function for various types of organisations.

Table 1.1 Some activities of the operations function in various organisations

Internet service provider	Fast-food chain	International aid charity	Furniture manufacturer
<ul style="list-style-type: none"> ● Maintain and update hardware ● Update software and content ● Respond to customer queries ● Implement new services ● Ensure security of customer data 	<ul style="list-style-type: none"> ● Locate potential sites for restaurants ● Provide processes and equipment to produce burgers, etc. ● Maintain service quality ● Develop, install and maintain equipment ● Reduce impact on local area ● Reduce packaging waste 	<ul style="list-style-type: none"> ● Provide aid and development projects for recipients ● Provide fast emergency response when needed ● Procure and store emergency supplies ● Be sensitive to local cultural norms 	<ul style="list-style-type: none"> ● Procure appropriate raw materials and components ● Make sub-assemblies ● Assemble finished products ● Deliver products to customers ● Reduce environmental impact of products and processes

The operations function is central to the organisation because it creates and delivers services and products, which is its reason for existing. The operations function is one of the three core functions of any organisation. These are:

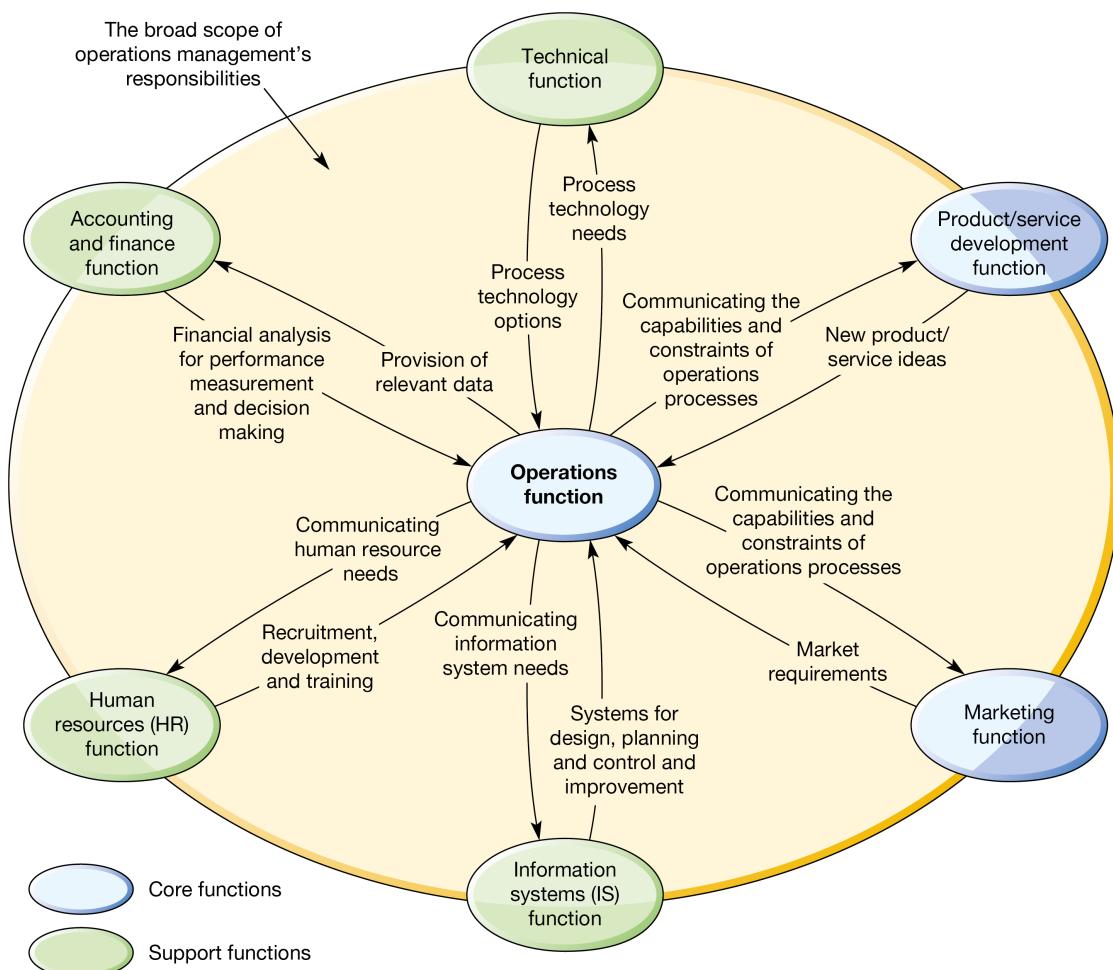
In addition, there are the support functions that enable the core functions to operate effectively. These include, for example, the accounting and finance function, the technical function, the human resources function and the information systems function. Remember that although different organisations may call their support functions by different names, almost all organisations will have the three core functions.

However, there is not always a clear division between functions. This leads to some confusion over where the boundaries of the operations function should be drawn. Here, we use a relatively broad definition of operations. We treat much of the product/service development, technical and information systems activities and some of the human resource, marketing, and accounting and finance activities as coming within the sphere of operations management. We view the operations function as comprising all the activities necessary for the day-to-day fulfilment of customer requests within the constraints of social and environmental sustainability. This includes sourcing services and products from suppliers and delivering services and products to customers.

Operations principle: Operations managers need to cooperate with other functions to ensure effective organisational performance.

Figure 1.2 illustrates some of the relationships between operations and other functions in terms of the flow of information between them. Although not comprehensive, it gives an idea of the nature of each relationship. Note that the support functions and core functions have different relationships with operations. Operations management's responsibility to support functions is primarily to make sure that they understand operations' needs and help them to satisfy these needs. The relationship with the other two core functions is more equal – less of 'this is what we want' and more 'this is what we can do currently – how do we reconcile this with broader business needs?'

Figure 1.2 Relationships between operations and other functions



A legend is presented as a guide with ovals in blue representing a core function and ovals in green representing a support function. A large circle has a blue oval labelled operations function in the centre. From the operations function oval there are arrows directed to and from ovals on the outer service of the large circle as follows. A blue oval labelled product and or service development has an arrow labelled new product and or service ideas pointed to the operations function. An arrow labelled communicating the capabilities and constraints of operations process points from the operations function oval to the product and or service oval. A blue oval labelled marketing function has an arrow labelled market requirements pointed at the operations function. An arrow labelled communicating the capabilities and constraints of operations processes points from the operations function oval to the marketing function oval. A green oval labelled information systems, or IS, function has an arrow labelled communicating information system needs pointed to it from the operations function oval. An arrow labelled systems for design, planning, and control and improvement is pointed from the IS function oval to the operations function oval. A green oval labelled human resources, or HR, function has an arrow labelled communicating human resource needs pointed to it from the operations function oval. An arrow labelled recruitment, development and training is pointed from the HR function oval to the operations function

oval. A green oval labelled accounting and finance function has an arrow labelled provision of relevant data pointed to it from the operations function oval. An arrow labelled financial analysis for performance measurement and decision making is pointed from the accounting and finance function oval to the operations function oval. A green oval labelled technical function has an arrow labelled process technology needs pointed to it from the operations function oval. An arrow labelled process technology options is pointed from the technical function oval to the operations function oval. There is an arrow that points into the circle labelled the broad scope of operation management's responsibilities.

Now take a short quiz to test your understanding so far.

Quiz 1.1 What is operations management?

1.2 Why is operations management important in all types of organisation?

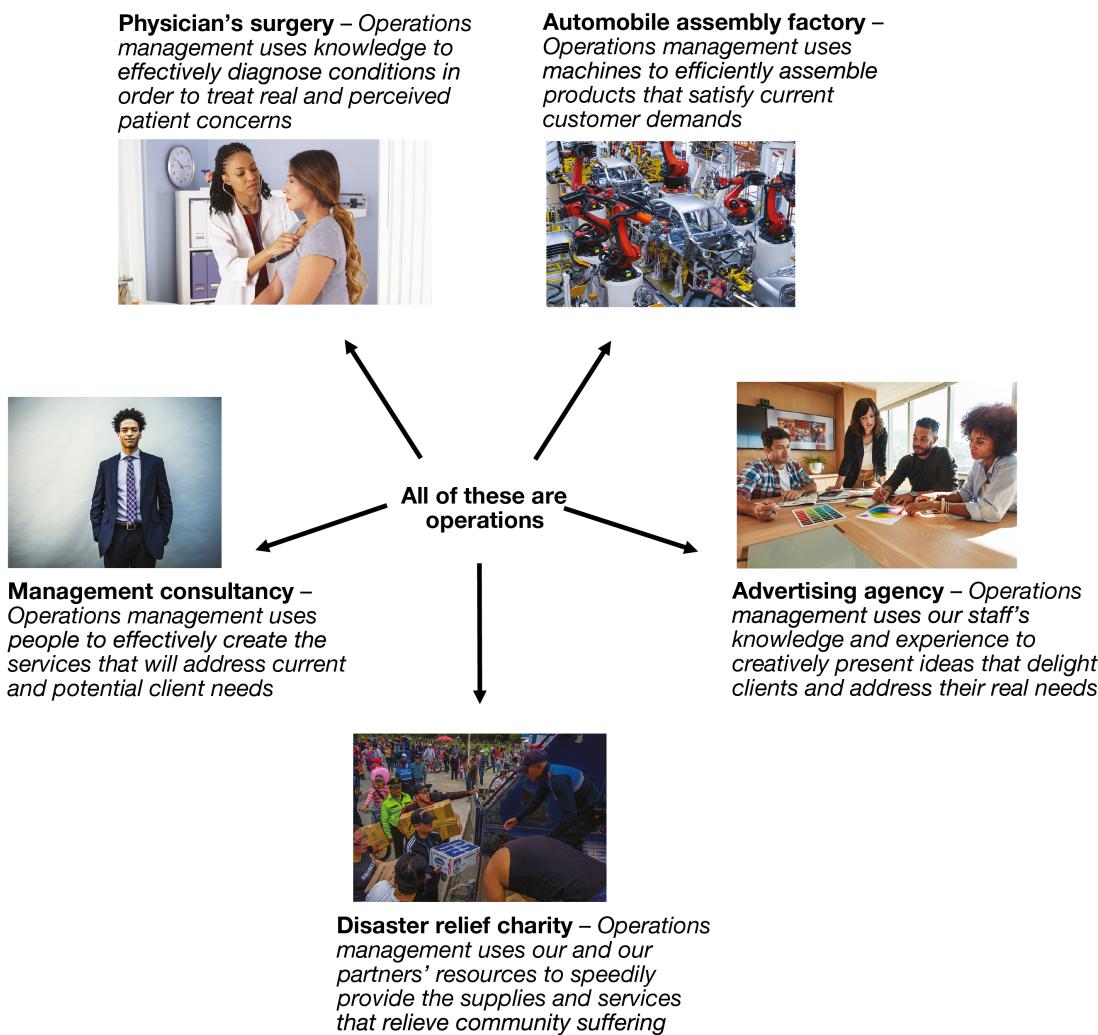
1.2 Recognise the importance of operations management in different types of organisation.

In some types of organisation, it is relatively easy to visualise the operations function and what it does, even if we have never seen it. For example, most people have seen images of a vehicle assembly line. But what about an advertising agency? We know vaguely what they do – they create the advertisements that we see online, in magazines and on television – but what is their operations function? The clue lies in the word ‘create’. Any business that creates something must use resources to do so, and so must have an operations activity. Also, the vehicle plant and the advertising agency do have one important element in common; both have a higher objective – to make a profit from creating and delivering their products or services. Yet not-for-profit organisations also use their resources to create and deliver services, not to make a profit, but to serve society in some way.

Operations Principle: The economic sector of an operation is less important than its intrinsic characteristics in determining how it should be managed.

Look at the examples of what operations management does in five very different organisations in **Figure 1.3** and some common themes emerge.

Figure 1.3 All of these are operations that produce some mix of products and services



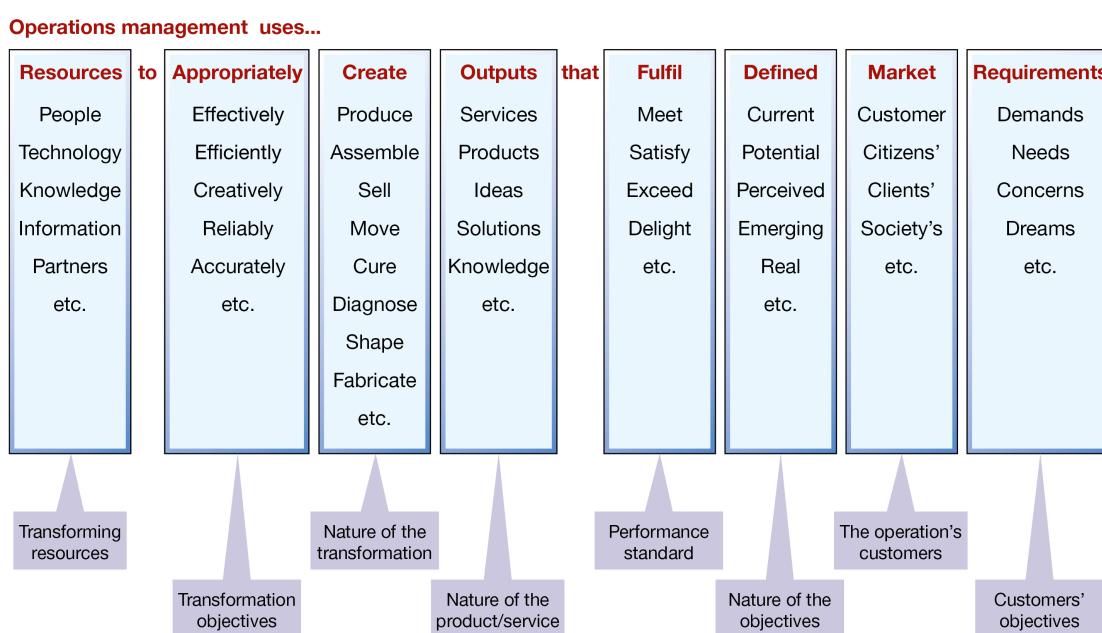
The types of operations are as follows. 1. Physician surgery, operations management uses knowledge to effectively diagnose conditions in order to treat real and perceived patient concerns. A photo depicts a female doctor using stethoscope to examine a patient. 2. Automobile assembly factory, operations management uses machines to efficiently assemble products that satisfy current customer demands. A photo depicts robots working in a car assembly line. 3. Advertising agency, operations management uses our staff's knowledge and experience to creatively present ideas that delight clients and address their real needs. A photo depicts a group of employees having a discussion in a meeting room. 4. Disaster relief charity, operations management uses our and our partners' resources to speedily provide the supplies and services that relieve community suffering. A photo depicts charity workers providing supplies to people. 5. Management consultancy, operations management uses people to effectively create the services that will address current and potential client needs. A photo depicts a man in business attire.

Source: Images clockwise from top left: Rocketclips, Inc/Shutterstock; TRMK/Shutterstock; Jacob Lund/Shutterstock; Fotos593/Shutterstock; MoMo Productions/Stone/Getty Images

Start with the statement from the ‘easy-to-visualise’ vehicle plant. Its summary of what operations management does is: ‘Operations management uses machines to efficiently assemble products that satisfy current customer demands’. The statements from the other organisations are similar but use slightly different language. Operations management uses not just machines but also ‘knowledge’, ‘people’, ‘our and our partners’ resources’ and ‘our staff’s knowledge and experience’, to efficiently (or effectively or creatively) assemble (or produce, change, sell, move, cure, shape, etc.) products (or services or ideas) that satisfy (or match or exceed or delight) customer (or clients’ or citizens’ or society’s) demands (or needs or concerns or even dreams).

Whatever terminology is used there is a common theme and a common purpose to how we can visualise the operations activity in any type of organisation; small or large, service or manufacturing, public or private, profit or not-for-profit. Operations management uses ‘resources to appropriately create outputs that fulfil defined market requirements’ (see **Figure 1.4**).

Figure 1.4 Operations management uses resources to appropriately create outputs that fulfil defined market requirements



The diagram is as follows. A box labelled resources lists people, technology, knowledge, information partners, and et cetera. Below this box is a comment box that indicates transforming resources. A box labelled appropriately lists effectively, efficiently, creatively, reliably, accurately, et cetera. Below this box is a comment box that indicates transformation objectives. A box labelled create lists produce, assemble, sell, move, cure, diagnose, shape. Fabricate, et cetera. Below this box is a comment box that

indicates nature of transformation. A box labelled outputs lists services, products, ideas, solutions, knowledge, and et cetera. Below this box is a comment box that indicates nature of the product and or service. A box labelled fulfil lists meet, satisfy, exceed, delight, et cetera. Below this box is a comment box that indicates performance standard. A box labelled defined lists current, potential, perceived, emerging, real, et cetera. Below this box is a comment box that indicates nature of the objectives. A box labelled market lists customer, citizens', clients', societies, et cetera. Below the box is a comment box indicating the operation's customers. A box labelled requirements lists demands, needs, concerns, dreams, et cetera. Below the box is a comment box labelled customers' objectives.

However, although the essential nature and purpose of operations management is the same in any type of organisation, there are some special issues to consider, particularly in smaller organisations and those whose purpose is to maximise something other than profit.

Smaller organisations and not-for-profit organisations

Operations management in the smaller organisation

Operations management is just as important in small organisations as it is in large ones. Irrespective of their size, all companies need to create and deliver their services and products efficiently and effectively. However, in practice, managing operations in a small or medium-size organisation has its own set of problems. Large companies may have the resources to dedicate individuals to specialised tasks, but smaller companies often cannot, so people may have to do different jobs as the need arises. Such an informal structure can allow the company to respond quickly as opportunities or problems present themselves. But decision making can also become confused as individuals' roles overlap. Small companies may have exactly the same operations management issues as large ones but they can be more difficult to separate from the mass of other issues in the organisation.

Operations management in not-for-profit organisations

Terms such as 'competitive advantage', 'markets' and 'business', which are used in *Operations Management*, are usually associated with companies in the for-profit sector. Yet operations management is also relevant to organisations whose purpose is not primarily to earn profits. Managing the operations in an animal welfare charity, hospital, research organisation or government department is essentially the same as in commercial organisations. Operations have to take the same decisions – how to create and deliver services and products, invest in technology, contract out some of their activities, devise performance measures, improve their operations performance and so on. However, the strategic objectives of not-for-profit organisations may be more complex and involve a greater emphasis on political, economic, social or environmental objectives. Because of this there may be a greater chance of operations decisions being made under conditions of conflicting objectives. For example, it is the operations staff in a children's welfare department who have to face the conflict between the cost of providing extra social workers and the risk of a child not receiving adequate protection. Nevertheless, the vast majority of the topics covered in *Operations Management* have relevance to all types of organisations, including non-profit, even if the context is different and some terms may have to be adapted.

On the next screen you will learn about operations in practice at the humanitarian organisation Médecins Sans Frontières.

Operations in practice: Médecins Sans Frontières

MSF operations provide medical aid to people in danger⁴



Source: Abaca Press/Alamy Stock Photo

Médecins Sans Frontières (MSF) is an independent humanitarian organisation providing medical aid where it is most needed, regardless of ‘race, religion, gender or political affiliation’ with actions ‘guided by medical ethics and the principles of neutrality and impartiality’ to raise awareness of the plight of the people they help in countries around the world. Its core work takes place in crisis situations – armed conflicts, epidemics, famines and natural disasters such as floods and earthquakes. Its teams deliver both medical aid (including consultations with a doctor, hospital care, nutritional care, vaccinations, surgery, obstetrics and psychological care) and material aid (including food, shelter, blankets, etc.). Each year, MSF sends doctors, nurses, logisticians, water and sanitation experts, administrators and other professionals to work alongside locally hired staff. It is one of the most admired and effective relief organisations in the world. But no amount of fine intentions can translate into effective action without superior operations management. MSF must be able to react to any crisis with fast response, efficient logistics systems, and efficient project management.

Its response procedures are being developed continuously to ensure that it reaches those most in need as quickly as possible. The process has five phases: proposal, assessment, initiation, running the project and closing. The information that prompts a possible mission can come from governments, humanitarian organisations, or MSF teams already present in the region. Once the information has been checked and validated, MSF sends a team of medical and logistics experts to the crisis area to carry out a quick evaluation. When approved, MSF staff start the process of selecting personnel, organising materials and resources and securing project funds. Initiating a project involves sending technical equipment and resources to the area. Thanks to its pre-planned processes, specialised kits and emergency stores, MSF can distribute material and equipment within 48 hours, ready for the response team to start work as soon as they arrive. Once the critical medical needs have been met, MSF begins to close the project with a gradual withdrawal of staff and equipment. At this stage, the project closes or is passed on to an appropriate organisation. MSF will also close a project if risks in the area become too great to ensure staff safety. Whether it is dealing with urgent emergencies, or a long-running programme, everything MSF does on the ground depends on efficient logistics. Often, aircraft can be loaded and flown into crisis areas within 24 hours. But, if it is not a dire emergency, MSF reduces its costs by shipping the majority of material and drugs by sea.

The new operations agenda

Changes in the business environment have had a significant impact on the challenges faced by operations managers. Some of them are in response to changes in the nature of demand. Many (although not all) industries have experienced increased cost-based competition while their customers' expectations of quality and variety have increased simultaneously.

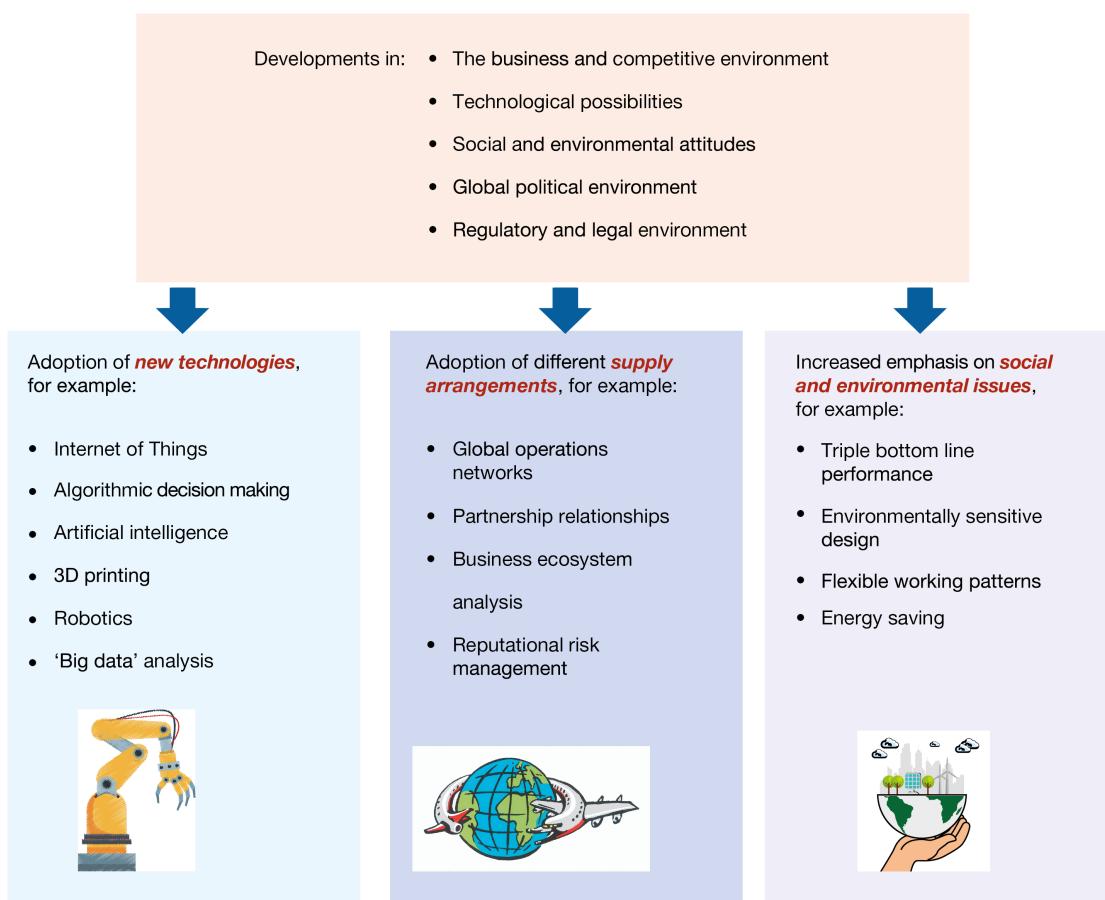
Operations principle: Operations management is at the forefront of coping with, and exploiting, developments in business and technology.

What is possible technologically is also changing rapidly, as are customers' attitudes to social and environmental issues. At the same time, political, legal and regulatory structures have changed. In response, operations managers have had to adjust their activities to cope, especially in the following areas:

- **New technologies** – In both manufacturing and service industries, process technologies are changing so fast that it is difficult to predict exactly what their effect will be, only a few years in the future. Certainly, they are likely to have a dramatic effect, radically altering the operating practices of almost all types of operation.
- **Different supply arrangements** – Some markets have become more global, while others have been constrained by politically inspired trade restrictions. Some globalised supply markets are opening up new sourcing options, other supply chains have become increasingly risky. Often, opportunities for cost savings must be balanced against supply vulnerability and ethical issues.
- **Increased emphasis on social and environmental issues** – Generally, customers, staff, and even investors, have been developing an increased ethical and environmental sensitivity, leading to operations having to change the way they conceive and create their products and services. Similarly, there is a greater expectation about the ethical treatment of all an operation's stakeholders, including customers, the workforce, suppliers and society in general.

Figure 1.5 identifies just some of the operations responses in these three areas. (If you don't recognise some of the terms, don't worry, they will be explained later.) These responses form a major part of a new agenda for operations.

Figure 1.5 Changes in the business environment are shaping a new operations agenda



The chart displays a box with the developments in business as follows. The business and competitive environments, technological possibilities, social and environmental attitudes, global political environment, and regulatory and legal environment. The chart then shows arrows leading to three boxes. The first box is adoption of new technologies with examples as follows: Internet of Things, algorithmic decision making, artificial intelligence, 3D printing, robotics, and big data analysis. The second box is adoption of different supply arrangements with examples as follows: Global operations networks, partnership relationships, business ecosystem analysis, and reputational risk management. The third box is increased emphasis on social and environmental issues with examples as follows: Triple bottom line performance, environmentally sensitive design, flexible work patterns, and energy saving. Each of the three boxes is illustrated with a small thumbnail image representing the subject areas.

The issues in **Figure 1.5** are not comprehensive, nor are they universal. But very few operations functions will be unaffected by at least some of them. The 'Operations in practice' examples throughout *Operations Management* look at various aspects of these three areas and 'Responsible operations' sections in each chapter look at social, environmental and ethical issues.

Now take a short quiz to test your understanding of the importance of operations management.

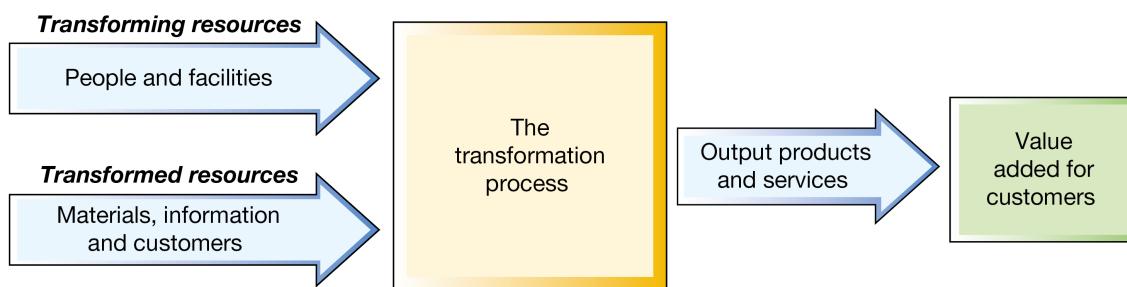
Quiz 1.2 Why is operations management important in all types of organisation?

1.3 What is the input–transformation–output process?

1.3 Identify the stages of the input-transformation-output process.

All operations create and deliver services and products by changing inputs into outputs using an ‘input–transformation–output’ process. **Figure 1.6** shows this general [transformation process model](#) that is the basis of all operations.

Figure 1.6 All operations are input–transformation–output processes



An arrow labelled transforming resources, people and facilities and another arrow labelled transformed resources, materials, information, and customers together lead to the transformation process. The transformation process leads via output product and services to value added for customers.

Put simply, operations take in a set of [input resources](#) that are used to transform something, or are transformed themselves, into outputs of services and products. And although all operations conform to this general input–transformation–output model, they differ in the nature of their specific inputs and outputs. For example, if you stand far enough away from a hospital or a vehicle plant, they might look very similar, but move closer and clear differences do start to emerge. One is a service operation delivering ‘services’ that change the physiological or psychological condition of patients; the other is a manufacturing operation creating and delivering ‘products’. What is inside each operation will also be different. The hospital contains diagnostic, care and therapeutic processes whereas the motor vehicle plant contains metal-forming machinery and assembly processes. Perhaps the most important difference between the two operations, however, is the nature of their inputs. The hospital transforms the customers themselves. The patients form part of the input to, and the output from, the operation. The vehicle plant transforms steel, plastic, cloth, tyres and other materials into vehicles.

Operations principle: All processes have inputs of transforming and transformed resources that they use to create products and services.

Inputs to the process

Inputs – transformed resources

One set of inputs to any operation's processes are transformed resources. These are the resources that are treated, transformed or converted in the process. They are usually a mixture of the following:

- **Materials** – operations that process materials could do so to transform their physical properties (shape or composition, for example). Most manufacturing operations are like this. Other operations process materials to change their location (parcel delivery companies, for example). Some, like retail operations, do so to change the possession of the materials. Finally, some operations store materials, such as warehouses.
- **Information** – operations that process information could do so to transform their informational properties (that is, the purpose or form of the information); accountants do this. Some change the possession of the information: for example, market research and social media operations aggregate and sell information. Some store the information, such as archives and libraries. Finally, some operations, such as telecommunication companies, change the location of the information.
- **Customers** – operations that process customers might change their physical properties in a similar way to materials processors: for example, hairdressers or cosmetic surgeons. Some, like hotels, store (or more politely, accommodate) customers. Airlines and mass rapid transport transform the location of their customers, while hospitals transform their physiological state. Some are concerned with transforming their psychological state: for example, most entertainment services such as music, theatre, television, radio and theme parks. But customers are not always simple ‘passive’ items to be processed. They can also play a more active part: for example, they create the atmosphere in a restaurant; they provide the stimulating environment in learning groups in education, and so on.

Operations principle: Transformed resource inputs to a process are materials, information or customers.

Some operations have inputs of materials *and* information *and* customers, but usually one of these is dominant. For example, a bank devotes part of its energies to producing printed statements by processing inputs of material, but no one would claim that a bank is a printer. The bank also is concerned with processing inputs of customers at its branches and contact centres. However, most of the bank's activities are concerned with processing inputs of information about its customers' financial affairs. As

customers, we may be unhappy with badly printed statements and we may be unhappy if we are not treated appropriately in the bank. But if the bank makes errors in our financial transactions, we suffer in a far more fundamental way. **Table 1.2** gives examples of operations with their dominant transformed resources.

Table 1.2 Dominant transformed resource inputs of various operations

Predominantly processing inputs of materials	Predominantly processing inputs of information	Predominantly processing inputs of customer
<ul style="list-style-type: none"> ● All manufacturing operations ● Mining companies ● Retail operations ● Warehouses ● Postal services ● Container shipping lines ● Trucking companies 	<ul style="list-style-type: none"> ● Accountants ● Bank headquarters ● Market research company ● Financial analysts ● News service ● University research unit ● Telecoms company 	<ul style="list-style-type: none"> ● Hairdressers ● Hotels ● Hospitals ● Mass rapid transports ● Theatres ● Theme parks ● Dentists

Inputs – transforming resources

The other set of inputs to any operations process are transforming resources. These are the resources that act upon the transformed resources. There are two types, which form the ‘building blocks’ of all operations:

- facilities – the buildings, equipment, plant and process technology of the operation.
- staff – the people who operate, maintain, plan and manage the operation. (Note we use the term ‘staff’ to describe all the people in the operation, at any level.)

The exact nature of both facilities and staff will differ between operations. To a five-star hotel, its facilities consist mainly of ‘low-tech’ buildings, furniture and fittings. To a nuclear-powered aircraft carrier, its facilities are ‘high-tech’ nuclear generators and sophisticated electronic equipment. Staff will also differ between operations. Most staff employed in a factory assembling domestic refrigerators may not need a very high level of technical skill. In contrast, most staff employed by an accounting company are, hopefully, highly skilled in their own particular ‘technical’ skill (accounting). Yet although skills

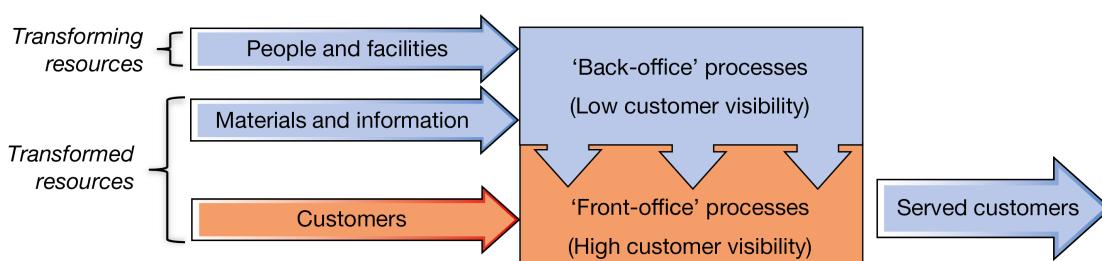
vary, all staff can make a contribution. An assembly worker who consistently misassembles refrigerators will dissatisfy customers and increase costs just as surely as an accountant who cannot add up. The balance between facilities and staff also varies. A computer chip manufacturing company, such as Intel, will have significant investment in physical facilities. A single chip fabrication plant will cost billions of dollars, so operations managers will spend a lot of their time managing their facilities. Conversely, a management consultancy firm depends largely on the quality of its staff. Here operations management is largely concerned with the development and deployment of consultant skills and knowledge.

Operations principle: All processes have transforming resources of facilities (equipment, technology, etc.) and people.

Front- and back-office transformation

A distinction that is worth noting at this point, mainly because it has such an impact on how transforming resources are managed, is that between ‘front-’ and ‘back-office’ transformation. The front-office (or ‘front-of-house’) parts of an operation are those processes that interact with (transform) customers. Back-office (or ‘back-of-house) operations are the processes that have little or no direct contact with customers, but perform the activities that support the front office in some way. The distinction is illustrated in **Figure 1.7**. But, as implied by the figure, the boundary between front and back offices is not clean. Different processes within an operation could have different degrees of exposure (what we refer to later as ‘visibility’) to customers.

Figure 1.7 Front office and back office



When the main transformed resource is the customers themselves, it is useful to distinguish between ‘front-office’ processes that act on customers directly and ‘back-office’ processes that provide indirect services

The diagram shows three arrows as follows. The first arrow is labelled transforming resources, people and facilities. The second arrow is transformed resources, materials and information. The third arrow is

labelled, transformed resources, customers. The first two arrows together lead to the back office processes, low customer visibility. The third arrow leads to the front office processes, high customer visibility. Next to the back and front office processes is a right arrow labelled, served customers.

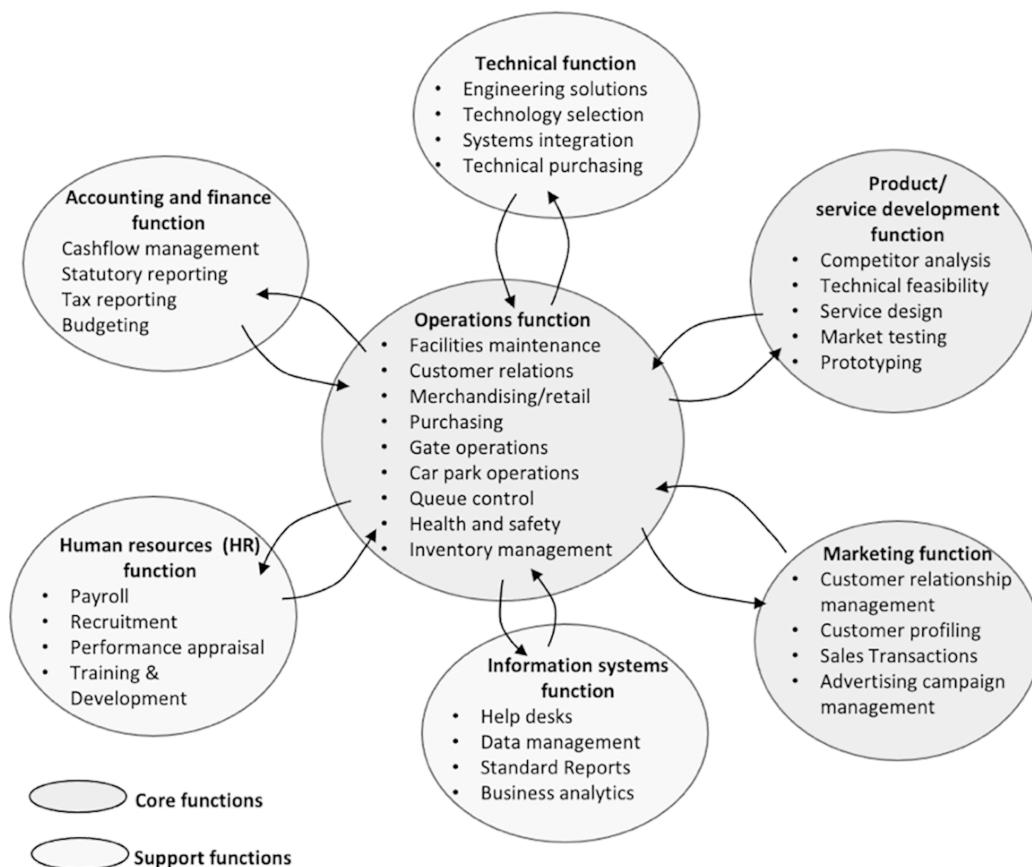
Now, think about the following question before revealing the answer.

What might be the 'back-office' processes in a theme park such as LEGOLAND? Use [Figure 1.2](#) as a starting point.

There are almost certainly (literally) hundreds of 'back-office' processes on which a theme park such as LEGOLAND depends. The figure below shows one such attempt, but note:

- This is simply an attempt to identify some of the likely processes. It is not a 'right answer'. In fact there will not be a 'right answer' as such, all parks will be different.
- Even if the processes themselves are a good representation of typical processes, the boundaries between functions are likely to be different in different operations.

Some typical processes within the operations function and other core and support functions of a theme park



The illustration is depicted as follows. The core functions are linked to support functions. The core functions are as follows. Operations function: facilities maintenance, customer relations, merchandising or retail, purchasing, gate operations, car park operations, queue control, health and

safety and inventory management. The operations function is linked to two other core functions. They are as follows. 1. Product or service development function: competitor analysis, technical feasibility, service design, market testing, prototyping. 2. Marketing function: customer relationship management, customer profiling, sales transactions, advertising campaign management. The operations function is linked to the following support functions. 1. Information systems function: help desks, data management, standard reports, business analytics. 2. Human resources function: payroll, recruitment, performance appraisal, training and development. 3. Accounting and finance function: cash flow management statutory reporting, tax reporting, budgeting. 4. Technical function: engineering solutions, technology selection, systems integration, technical purchasing.

On the next screen you will explore an example of operations in practice at Marina Bay Sands Hotel, part of the hospitality industry, where back and front offices work together.

Operations in practice: Marina Bay Sands Hotel

Marina Bay Sands Hotel⁵



Source: Vichy Deal/Shutterstock

There are very few better examples of how back and front offices work together than the hotel industry. As customers, we naturally judge a hotel primarily on its front-office, client-facing, staff and facilities, but without effective back-office operations, customers would soon find that their front-office experience would be very much affected. This is certainly true for the Marina Bay Sands hotel in Singapore. Located in the heart of Singapore's Central Business District, Marina Bay Sands is an integrated, multi-award-winning, luxury resort owned by the Las Vegas Sands corporation, incorporating a hotel with over 2,500 rooms, a huge convention and exhibition centre, restaurants, a shopping mall, museum, two large theatres and the world's largest atrium casino. The hotel's three towers are crowned by the spectacular Sands SkyPark, which offers a 360-degree view of Singapore's skyline. It is home to lush gardens, an infinity edge swimming pool and an observation deck.

But the meticulous service provided by the hotel's highly trained front-of-house staff could not happen without the many back-of-house processes that customers do not always notice. Some of these processes are literally invisible to customers, for example those that keep the accounts, or those that maintain the

hotel's air-conditioning systems, or the dim sum preparation (dim sum are steamed dumplings served in small, bite-sized portions - specialist chefs prepare 5,000 individual pieces every day). These processes are all important, and mass operations in their own right. Some back-of-house departments rely more on technology. The hotel's laundry must clean and press 4,000 pool towels every day, as well as thousands of items of room linen. Which is a problem for an organisation whose sustainability policy commits it to minimising its use of water. It took an investment of over £10 million in water-saving technology to reduce the hotel's usage by 70 per cent. Other back-of-house operations have a direct impact on how customers view the hotel. For example, the wardrobe department that keeps the hotel's over 9,000 staff looking smart is reputed to be the most high-tech in the world. Its 18 automated conveyors each have slots for 620 individual items of uniform, all of which have individual identification chips so that they can be tracked. Staff enter their number into a keypad, and, behind the scenes, the conveyor system automatically delivers the uniform. Some processes straddle the front-of-house/back-of-house divide. The valet parking operation parks up to 200 cars each hour in its 2,500 parking spaces, and retrieves them in a target retrieval time of seven minutes. Housekeeping cleans, tidies and stocks all the bedrooms. The hotel's 50 butlers serve the more exclusive suites and cater for a wide variety of demands (one guest asked them to arrange a wedding banquet at four hours' notice). It is a role that demands dedication and attention to detail.

Outputs from the process

Operations create products and services. Products and services are often seen as different. Products are physical things whereas services are activities or processes. A car or a newspaper or a restaurant meal is a product, whereas a service is the activity of the customer using or consuming that product. Yet, although some services do not involve many physical products, and some manufacturers do not give much service, most operations produce some mixture of products and services, even if one predominates. For example, services like consultancies produce reports, hairdressers sell hair gel and food manufacturers give advice on how to prepare their products.

Products or services, or does it matter?

The difference between a 'product' and a 'service' is not always obvious and has provoked a lot of (not always useful) academic debate. At an obvious, but simple, level, a product is a physical and tangible thing (you can touch a car, or television or phone). By contrast, a service is an activity that usually involves interaction with a customer (as with a doctor) or something representing the customer (as with a package delivery service). The resources that carry out these services may be tangible, but not the service they provide.

Operations principle: Most operations produce a blend of tangible products and intangible services.

Think about five services that you have 'consumed' in the last week. Try and make these as varied as possible. Examples could include public transport, a bank, any shop or supermarket, attendance at an education course, a cinema, a restaurant, etc. Try to identify how these services are different and how they are similar.

Obviously, this question will depend on exactly which services are chosen. However, for each of these services, one could usefully ask the following questions:

- Did the service meet your expectations? Is so what did the management of the service have to do well in order to satisfy your expectations? If not, where did they fail? Why might they have failed?
- If you were in charge of managing the delivery of these services, what would you do to improve the service?
- If they wanted to, how could the service be delivered at a lower cost so that the service could reduce its prices?
- How do you think that the service copes when something goes wrong (such as a piece of technology breaking down)?
- Which other organisations might supply the service with products and services? (In other words, they are your 'supplier', but who are their suppliers?)
- How do you think the service copes with fluctuation of demand over the day, week, month or year?

These questions are just some of the issues that the operations managers in these services have to deal with. Think about the other issues they will have to manage in order to deliver the service effectively.

For many years the accepted distinction between products and services was not confined to intangibility, but included other characteristics abbreviated to ‘IHIP’, standing for:

- Intangibility, in that they are not physical items.
- Heterogeneity, in that they are difficult to standardise because each time a service is delivered, it will be different because the needs and behaviour of customers will, to some extent, vary.
- Inseparability, in that their production and consumption are simultaneous. The service provider (who ‘produces’ the service) is often physically present when its consumption by a customer takes place.
- Perishability, in that they cannot be stored because they have a very short ‘shelf life’. They may even perish in the very instant of their creation, like a theatre performance.

However, there are several problems with using these characteristics to define a ‘service’ – hence the academic debate. It is certainly not difficult to find examples of services that do not conform to them. Also, technology has had a significant effect; both on the extent to which the IHIP characteristics apply and how the limits that they place on service operations can be overcome. In particular, the development of information and communication technology has opened up many new types of service offerings. Yet, although they cannot totally define what is a ‘service’ and what is a ‘product’, each of the IHIP characteristics does have some validity.

Most operations produce outputs somewhere on a spectrum of the IHIP characteristics

Some operations produce just products. For example, mineral extraction operations (miners) are concerned almost exclusively with the product that comes from their mines. It is tangible, almost totally standardised, produced away from its consumption, and storable. Others produce just services. For example, a psychotherapy clinic provides personalised and close-contact therapeutic treatment for its customers with few, if any, tangible elements. However, most operations produce outputs that are somewhere in-between the two extremes, or a blend of the two. **Figure 1.8** shows a number of the operations described in this chapter positioned in a spectrum using the IHIP characteristics, from almost ‘pure’ goods producers to almost ‘pure’ service producers.

Figure 1.8 The output from most types of operations blend characteristics of ‘pure’ goods and ‘pure’ services



The continuum is labelled, pure products on the left end and pure services on the right end.

- Intangibility. Pure products, some significant tangible elements. Pure services, no tangible elements.
- Heterogeneity. Pure products, largely standardised. Pure services, not at all standardised.
- Inseparability. Pure products, production and consumption can be separated. Pure services, production and consumption totally simultaneous.
- Perishability. Pure products, storage possible. Pure services, no storage possible.

The outputs of four operations are plotted across the continuum. From left to right, they are LEGO and Fjällräven, Philips Lighting, MSF, LEGOLAND and Marina Bay Sands hotel. Each plot zig zags back and forth, showing that some characteristics of the operation trend toward either pure products or services, while others trend in the opposite direction.

Both LEGO and Fjällräven are classic manufacturers on the left of the spectrum, making standard products. At the other extreme, LEGOLAND and the Marina Bay Sands hotel are (to slightly different degrees) producing intangible services. MSF and Philips lighting are somewhere in between.

Using IHIP characteristics to distinguish between different types of output is of more than theoretical interest; they have real operational consequences. For example:

- Intangibility means it is difficult to define the ‘boundary’ of the less tangible elements of service. It therefore becomes particularly important to manage customers’ expectations as to what the service comprises.
- Heterogeneity means that every service is different and difficult to standardise. Customers could ask for elements of service that are difficult to predict and may be outside the operation’s capabilities. Cost efficiencies become difficult and staff must be trained to cope with a wide variety of requests.
- Inseparability means that production and consumption are simultaneous. So, to meet all demand, operations must have sufficient capacity in place to meet demand as it occurs. However, customer guidance can reduce the need for contact (e.g. the use of FAQs on a website).
- Perishability means that an operation’s output is difficult to store and ceases to have value after a relatively short time, so matching capacity with demand (or vice versa) is important to avoid either underutilised resources or lost revenue.

Services and products are merging (and changing)

Increasingly the distinction between services and products is seen as not particularly useful. Some authorities see the essential purpose of all businesses, and therefore all operations, as being to ‘serve customers’. Therefore, they argue, all operations are service providers who may (or may not) produce physical products as a means of serving their customers. This idea, that all operations should be seen as offering ‘value propositions’ through service, is called ‘service-dominant logic’.⁶ Among other things, it holds that service is the fundamental basis of exchange, that physical goods are simply the distribution mechanisms for the provision of service, and that the customer is always the co-creator of value. Our approach in this text is close to this in that we treat operations and process management as being important for all organisations. Whether they see themselves as manufacturers or service providers is very much a secondary issue.

Servitisation

A term that is often used to indicate how operations, which once considered themselves exclusively producers of products, are becoming more service-conscious is servitisation (or servitization).

Servitisation involves (often manufacturing) firms developing the capabilities they need to provide services and solutions that supplement their traditional product offerings. The best-known example of how servitisation works was when Rolls-Royce, the aero engine manufacturer, rather than selling individual engines, offered the option of customers being able to buy ‘power-by-the-hour’. What this meant was that many of its customers in effect bought the power the aero engine delivers, with Rolls-Royce providing both the physical engines and all of the support (including maintenance, training, updates and so on) to ensure that they could continue to deliver power. This may sound like a small change, but the effects were important. First, Rolls-Royce became a provider of service (the power to make the aircraft fly) as opposed to a manufacturer of technically complex products. Second, it means that what customers really want (the reliable provision of power) and the objectives of the company are more closely aligned. Third, it provides an opportunity for companies to earn additional revenue from new services.

Operations principle: Servitisation involves firms developing the capabilities to provide services and solutions that supplement their traditional product offerings.

Servitisation in practice is shown in the example of Philips Lighting, on the next screen.

Operations in practice: Philips Lighting

Servitisation and circular design at Philips Lighting⁷

Operations managers are increasingly having to re-evaluate how they think about their products and services and how they produce them. Take, for example, Philips Lighting,⁸ which responded to developments in its markets by combining and adopting two important changes to operations practice – servitisation and the circular economy.

The company's servitisation offering is called 'lighting-as-a-service' (LaaS), where it takes care of its customers' lighting needs, from the initial design and installation of the lighting, to the operation and maintenance. By doing this, customers can save money because they pay only for the light they use, while at the same time avoiding the disturbance of having to replace and dispose of burnt-out bulbs or having to navigate system upgrades. The company originally became interested in LaaS when the architect Thomas Rau worked with Philips Lighting to supply a novel 'pay-per-lux' intelligent lighting system that was customised to fit the requirements of the Amsterdam office space of RAUArchitects, while also reducing price. When considering his lighting needs, Rau wanted to avoid buying an expensive over-engineered lighting system, only to eventually have to dispose of and replace it. Instead, he would rather purchase just the right amount of light 'as a service' that would suit the building. RAU and Philips developed a system that created a minimalist light plan making as much use as possible of the building's natural sunlight. It combined a sensor and controller system that helped keep energy use to an absolute minimum, by darkening or brightening the artificial lighting in response to motion within a space or the presence of daylight. From the customer's point of view, they not only save money by paying only for the light they use but also find it easier to optimise their use of energy, while avoiding the effort of managing the system. From the supplier's point of view, the agreement allowed Philips to retain control over how the lighting system worked, what products were supplied, how the system was maintained, how it was reconditioned and eventually how its products were recycled.



Source: Mirjam Claus/Shutterstock

The company struck a similar deal for the terminal buildings at Amsterdam Airport Schiphol. The airport pays only for the light it uses, while Philips remains the owner of all fixtures and installations, responsible for the performance and durability of the system and eventually its reuse and recycling at the end of its useful life. The collaboration between the supplier and user of the service resulted in reduced maintenance costs (because components could be individually replaced instead of the entire fixture being recycled) contributing to Schiphol's ambitious sustainability targets.

Customers

Any discussion about the nature of outputs from operations must involve consideration of the customers for whom they are intended.

Customers are part of the process – co-creation and co-production

If all operations can be seen as producing services, and services act on customers or their surrogates, then the role of customers in an operation's output should be considered. This is not a new idea, nor is it unusual for customers to play a central part in how they derive value from an operation's outputs (they take themselves around a supermarket, for example). Patients visiting the doctor with an ailment are required to describe their symptoms and discuss alternative treatments – the better they can do this, the better the value they derive. This idea of customer involvement is important because the distinction between the roles of 'producer' and 'consumer' are being blurred. The concept is usually known either as co-creation or co-production – there is some disagreement in what the two terms mean. Often co-creation implies customer involvement in the design of a product or service, and co-production is just the production of a pre-designed offering. The important point is that there is often a degree of customer involvement, engagement, participation or collaboration within an operation. The idea has important implications for all operations. Not only does it emphasise the importance of customers in shaping how an operation's outputs can create value, it establishes the importance of a full two-way interaction between an operation and its customers.

Remember that although customers may also be an input to many operations, they are also the reason for their existence. Nor should 'customers' be seen as a homogeneous group. Marketing professionals spend much of their effort in trying to understand how customers can be usefully grouped together, the better to understand their various needs. This is called 'market segmentation', and is beyond the scope of this text. However, the implications of it are very important for operations managers. In essence, it means that different customer groups may want different things from an operation. We discuss this issue further in **Chapter 3**.

B2B and B2C

One distinction between different types of customers is worth describing at this point, because we shall be using the terminology at other points in the text. That is between business-to-business (B2B) and business-to-consumer (B2C) operations. B2B operations are those that provide their products or services

to other businesses. B2C operations provide their products or services direct to the consumers who (generally) are the ultimate users of the outputs from the operation. Serving individual customers and serving other businesses are very different. This means that the operations serving these two types of customers will be faced with different kinds of concerns, and probably be organised in different ways. Yet an understanding of customers is always important (whether business customers, or consumers). Without them, there would be no operation. It is critical that operations managers are aware of customers' needs, both current and potential.

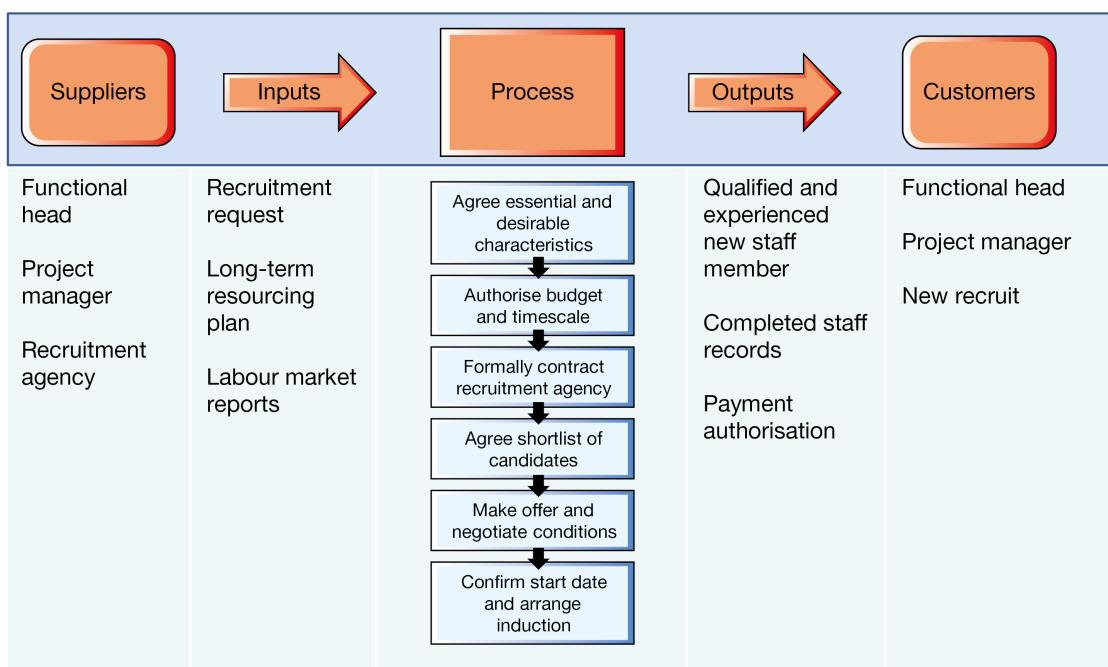
Operations principle: An understanding of customer needs is always important, whether customers are individuals or businesses.

SIPOC analysis

Although the idea of the ‘input–transformation–output’ model is essentially simple, it can be the basis of a useful first step in understanding and improving processes. This is sometimes called [SIPOC analysis](#).

SIPOC stands for suppliers, inputs, process, outputs and customers. It is a method of formalising a process at a relatively general rather than a detailed level. **Figure 1.9** shows an example that describes a recruitment process performed by the human resources function of a company. The advantage of such an analysis is that it helps all those involved in the process to understand (and, more important, agree) what it involves and where it fits within the business. More than this, it can prompt important questions that can sometimes be overlooked. For example, exactly what information should suppliers to the process provide? In what form should the information be given? What are the important steps in the process and who is responsible for them? And so on.

Figure 1.9 A simple SIPOC analysis for a recruitment process performed by the human resources function of a company



The diagram is as follows. The suppliers provides input to process. The process gives output to customers. The types of suppliers are as follows. Functional head, project manager, and recruitment agency. The types of inputs are as follows. Recruitment request, long term resourcing plan, and labour market reports. The processes in the sequence are as follows. Agree essential and desirable characteristics. Authorise budget and timescale. Formally contract recruitment agency. Agree shortlist of

candidates. Make offer and negotiate conditions. Confirm start date and arrange induction. The types of outputs are as follows. Qualified and experienced new staff member, completed staff records, and payment authorisation. The types of customers are as follows. Functional head, project manager, and new recruit.

Now take a short quiz to test your understanding of the input-transformation-output process.

Quiz 1.3 What is the input-transformation-output process?

1.4 What is the process hierarchy?

1.4 Define the process hierarchy.

So far, we have discussed operations management and the input–transformation–output model, at the level of ‘the operation’. For example, we have described the toy manufacture, the theme park, the disaster relief operation and the hotel. But look inside any of these operations. One will see that all operations consist of a collection of processes (although these processes may be called ‘units’ or ‘departments’) interconnecting with each other to form an internal network. Each process acts as a smaller version of the whole operation of which it forms a part. Within any operation, the mechanisms that actually transform inputs into outputs are these processes. A process is an arrangement of resources and activities that transform inputs into outputs that satisfy (internal or external) customer needs. They are the ‘building blocks’ of all operations, and they form an ‘internal network’ within an operation. Each process is, at the same time, an internal supplier and an internal customer for other processes. This ‘internal customer’ concept provides a model to analyse the internal activities of an operation. It is also a useful reminder that, by treating internal customers with the same degree of care as external customers, the effectiveness of the whole operation can be improved. **Table 1.3** illustrates how a wide range of operations can be described in this way.

Table 1.3 Some operations described in terms of their processes

Operation	Some of the operation’s processes
Airline	Passenger check-in assistance, baggage drop, security/seat check, board passengers, fly passengers and freight around the world, flight scheduling, in-flight passenger care, transfer assistance, baggage reclaim, etc.
Department store	Source merchandise, manage inventory, display products, give sales advice, sales, aftercare, complaint handling, delivery service, etc.
Police service	Crime prevention, crime detection, information gathering/collating, victim support, formally charging/detaining suspects, managing custody suites, liaising with court/justice system, etc.
Ice cream manufacturer	Source raw materials, input quality checks, prepare ingredients, assemble products, pack products, fast freeze products, quality checks, finished goods

inventory, etc.

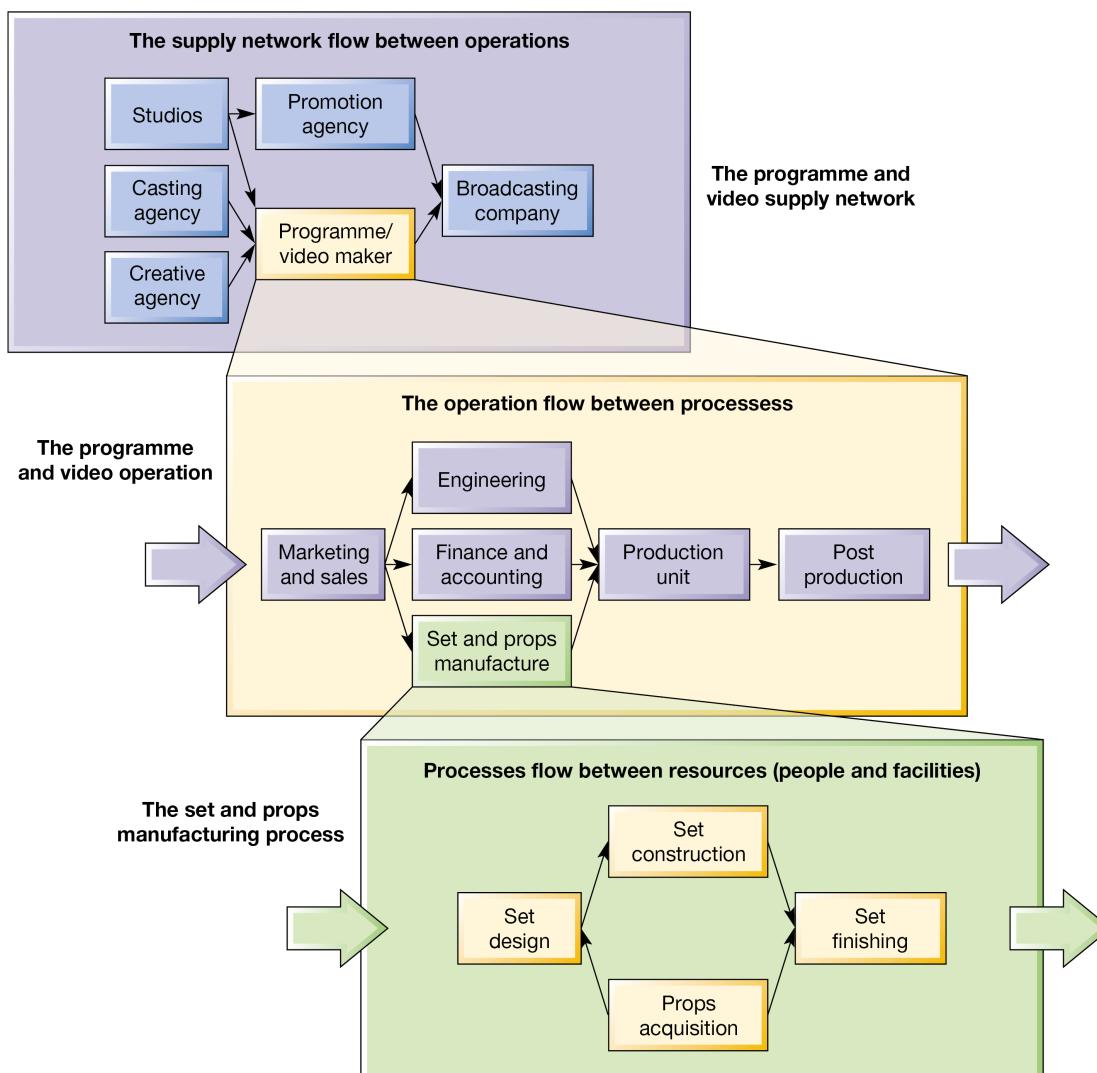
Within each of these processes is another network of individual units of resource such as individual people and individual items of process technology (machines, computers, storage facilities, etc.). Again, transformed resources flow between each unit of transforming resource. Any business, or operation, is made up of a network of processes and any process is made up of a network of resources. But also, any business or operation can itself be viewed as part of a greater network of businesses or operations. It will have operations that supply it with the services and products it needs, and unless it deals directly with the end consumer, it will supply customers who themselves may go on to supply their own customers. Moreover, any operation could have several suppliers and several customers, and may be in competition with other operations creating similar services or products to itself. This network of operations is called the [supply network](#). In this way, the input–transformation–output model can be used at a number of different ‘levels of analysis’.

Operations principle: A process perspective can be used at three levels: the level of the operation itself, the level of the supply network, and the level of individual processes.

Here we have used the idea to analyse businesses at three levels: the process, the operation and the supply network. But one could define many different ‘levels of analysis’, moving upwards from small to larger processes, right up to the huge supply network that describes a whole industry.

This idea is called the ‘[hierarchy of operations](#)’ or the [process hierarchy](#), and is illustrated for a business that makes television programmes and videos in **Figure 1.10**.

Figure 1.10 Three levels of operations management analysis: the supply network, the operation and the process



The diagram depicts operations and process analysis within a programme and video business through the supply network, the operation, and the process as follows. A large box labelled the supply network flow has three boxes inside labelled studios, casting agency, and creative agency. These boxes leads to programme or video maker and studios box leads to promotion agency. The boxes for programme or video maker and studios lead to broadcasting company. The box for programme or video maker is enlarged further to show the programme and video operation. The operation flow between processes is as follows. Marketing and sales leads to engineering, finance and accounting, and set and props manufacture. These three components together leads to production unit which further leads to post production. The box for set and props manufacture is enlarged to show the set and props manufacturing process. The processes flow between resources (people and facilities) is as follows. Set design leads to set construction and props acquisition, which together lead to set finishing.

It has inputs of production, technical and administrative staff, cameras, lighting, sound and recording equipment, and so on. It transforms these into finished programmes, promotional videos, etc. At a more

macro level, the business itself is part of a whole supply network, acquiring services from creative agencies, casting agencies and studios, liaising with promotion agencies, and serving its broadcasting company customers. At a more micro level within this overall operation there are many individual processes, manufacturing the sets, marketing its services, maintaining and repairing technical equipment, producing the videos and so on. Each of these individual processes can be represented as a network of yet smaller processes, or even individual units of resource. For example, the set manufacturing process could comprise four smaller processes – designing the sets, constructing them, acquiring the props and finishing the sets.

Critical commentary

The idea of the internal network of processes is seen by some as being over-simplistic. In reality, the relationship between groups and individuals is significantly more complex than that between commercial entities. One cannot treat internal customers and suppliers exactly as one does external customers and suppliers. External customers and suppliers usually operate in a free market. If an organisation believes that in the long run it can get a better deal by purchasing services and products from another supplier, it will do so. But internal customers and suppliers are not in a ‘free market’. They cannot usually look outside either to purchase input resources or to sell their output services and products (although some organisations are moving this way). Rather than take the ‘economic’ perspective of external commercial relationships, models from organisational behaviour, it is argued, are more appropriate.

Operations management is relevant to all parts of the business

The example in Figure 1.10 demonstrates that it is not just the operations function that manages processes; all functions have processes.

Operations principle: All parts of the business manage processes, so all parts of the business have an operations role and need to understand operations management principles.

For example, the marketing function has processes that create demand forecasts, create advertising campaigns, create marketing plans, etc. All functions of the organisation have processes that need managing.

Operations principle: Processes are defined by how the organisation chooses to draw process boundaries.

Each function has its ‘technical’ knowledge, such as marketing expertise, finance expertise and so on. Yet each will also have a ‘process management’ role in producing its services. So, because all managers have some responsibility for managing processes, they are, to some extent, operations managers. They all should want to give good service to their (often internal) customers, and they all will want to do this efficiently. So, operations management is relevant for all functions, and all managers should have something to learn from the principles, concepts, approaches and techniques of operations management.

It also means that we must distinguish between two meanings of ‘operations’:

- ‘Operations’ as a function, meaning the part of the organisation that creates and delivers services and products for the organisation’s external customers;
- ‘Operations’ as an activity, meaning the management of the processes within any of the organisation’s functions.

Table 1.4 illustrates just some of the processes that are contained within some of the more common non-operations functions, the outputs from these processes and their ‘customers’.

Table 1.4 Some examples of processes in non-operations functions

Organisational	Some of its processes	Outputs from its processes	Customer(s) for its
----------------	-----------------------	----------------------------	---------------------

function			outputs
Marketing and sales	<ul style="list-style-type: none"> ● Planning process ● Forecasting process ● Order-taking process 	<ul style="list-style-type: none"> ● Marketing plans ● Sales forecasts ● Confirmed orders 	<ul style="list-style-type: none"> ● Senior management ● Sales staff, planners, operations ● Operations, finance
Finance and accounting	<ul style="list-style-type: none"> ● Budgeting processes ● Capital approval processes ● Invoicing processes 	<ul style="list-style-type: none"> ● Budgets ● Capital request evaluations ● Invoices 	<ul style="list-style-type: none"> ● Everyone ● Senior management, requesters ● External customers
Human resources management	<ul style="list-style-type: none"> ● Payroll processes ● Recruitment processes ● Training processes 	<ul style="list-style-type: none"> ● Salary statements ● New hires ● Trained employees 	<ul style="list-style-type: none"> ● Employees ● All other processes
Information technology	<ul style="list-style-type: none"> ● Systems review process ● Help desk process ● System implementation project processes 	<ul style="list-style-type: none"> ● System evaluation ● Systems advice ● Implemented working systems and aftercare 	<ul style="list-style-type: none"> ● All other processes in the business

Quiz 1.4 What is the process hierarchy?

1.5 How do operations (and processes) differ?

1.5 Use the 4Vs model to compare operations.

Although all operations processes are similar in that they all transform inputs, they do differ in a number of ways, four of which, known as the four Vs, are particularly important:

- The volume of their output.
- The variety of their output.
- The variation in the demand for their output.
- The degree of visibility that the creation of their output has for customers.

Operations principle: The way in which processes need to be managed is influenced by volume, variety, variation and visibility.

The next four screens will explain each V dimension in detail.

The volume dimension

Take a familiar example of high-volume hamburger production. McDonald's serves millions of burgers around the world every day. Volume has important implications for the way McDonald's operations are organised. The first thing you notice is the repeatability of the tasks people are doing and the systemisation of the work, where standard procedures are set down specifying how each part of the job should be carried out. Also, because tasks are systematised and repeated, it is worthwhile developing specialised fryers and ovens. All this gives low unit costs. Now consider a small local cafeteria serving a few 'short order' dishes. The range of items on the menu may be similar to the larger operation, but the volume will be far lower, so the repetition will also be far lower, as will the number of staff (possibly only one person), so individual staff probably perform a wider range of tasks. This may be more rewarding for the staff, but less open to systemisation. Also, it is less feasible to invest in specialised equipment. So the cost per burger served is likely to be higher (even if the price is comparable).



Source: Piotr Piatrouski/Shutterstock

The variety dimension

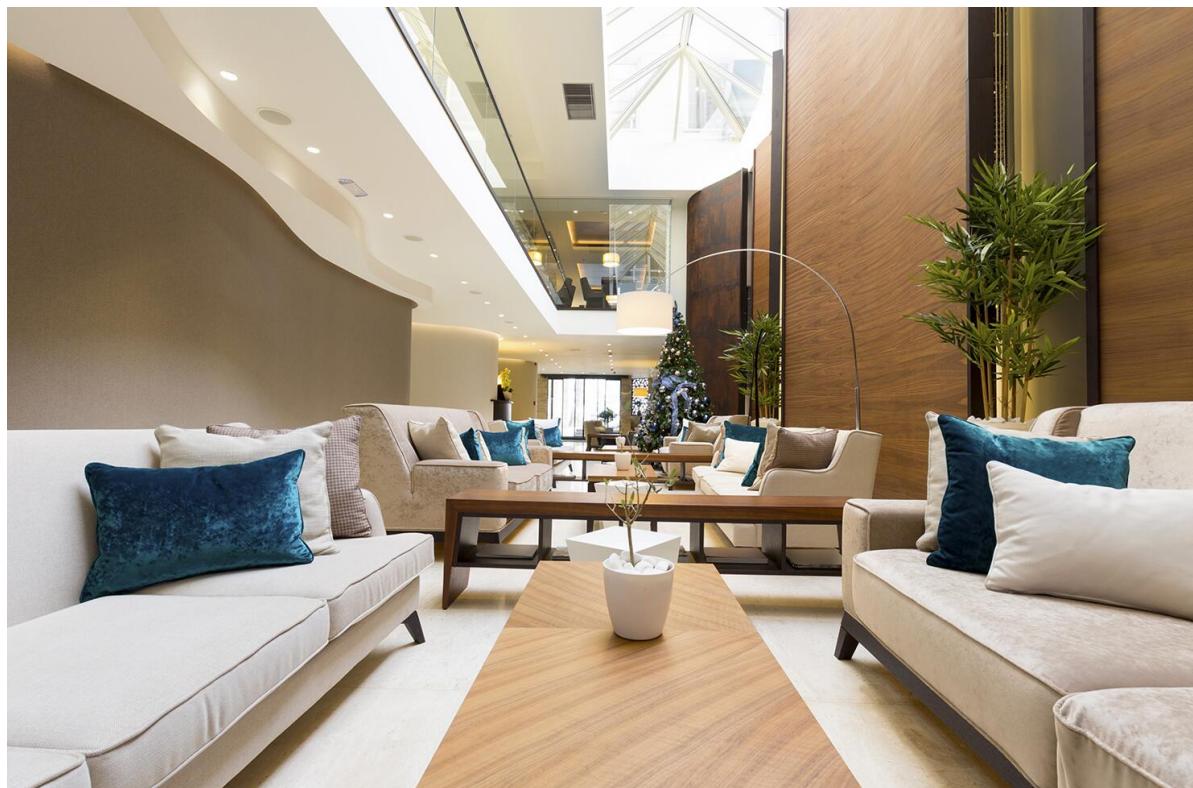
A taxi company offers a relatively high-variety service. It is prepared to pick you up from almost anywhere and drop you off almost anywhere. To do this it must be flexible. Drivers must have a good knowledge of the area, and communication between the base and the taxis must be effective. However, the cost per kilometre travelled will be higher for a taxi than for a less customised form of transport such as a bus service. Although both provide the same basic service (transportation), the taxi service has a higher variety of routes and times to offer its customers, while the bus service has a few well-defined routes, with a set schedule. Little, if any, flexibility is required from the bus operation. All is standardised and regular, which results in relatively low costs compared with using a taxi for the same journey.



Source: Naki Kouyioumtzis/Pearson Education Ltd

The variation dimension

Consider the demand pattern for a summer holiday resort hotel. Not surprisingly, more customers want to stay in summer vacation times than in the middle of winter. At the height of ‘the season’ the hotel could be full to capacity, but off-season demand could be a small fraction of its capacity. Such a marked variation in demand means that the operation must change its capacity in some way: for example, by hiring extra staff for the summer. But, a hotel with high variation in demand will probably have high recruitment costs, overtime costs and underutilisation of its rooms, all of which increase the hotel’s costs. By contrast, a hotel with level demand can plan its activities well in advance. Staff can be scheduled, food can be bought and rooms can be cleaned in a routine and predictable manner. This results in a high utilisation of resources and lower unit costs.



Source: Edvard Nalbantjan/123RF

The visibility dimension

'Visibility' is slightly more difficult to envisage. It means how much of the operation's activities its customers experience, or how much the operation is exposed to its customers. Generally, customer-processing operations are more exposed to their customers than material- or information-processing operations. But even customer-processing operations have some choice as to how visible they wish to be. For example, a retailer could operate as a high-visibility 'bricks and mortar' shop or a lower-visibility web-based operation. A high-visibility 'bricks and mortar' operation will conform to most of the IHIP characteristics described previously. Customers will directly experience most of its 'value-adding' activities. They are likely to demand a relatively short waiting time. Their perceptions, rather than objective criteria, will also be important in how they judge the service. Customers could also request services or products that clearly would not be sold in such a shop, resulting in 'high received variety'. All of which make it difficult for high-visibility operations to keep costs down.

Conversely, a web-based retailer, while not a pure low-contact operation, has far lower visibility. Behind its website, it can be more 'factory-like'. The time lag between the order being placed and the items ordered by the customer being retrieved and dispatched does not have to be minutes, as in the shop, but can be hours or even days. Also, there can be relatively high staff utilisation. The web-based organisation can also centralise its operation on one (physical) site, whereas the 'bricks and mortar' shop needs many shops close to centres of demand. Therefore, the low-visibility web-based operation will have lower costs than the shop.



Source: primagefactory/123RF

The implications of the four Vs of operations processes

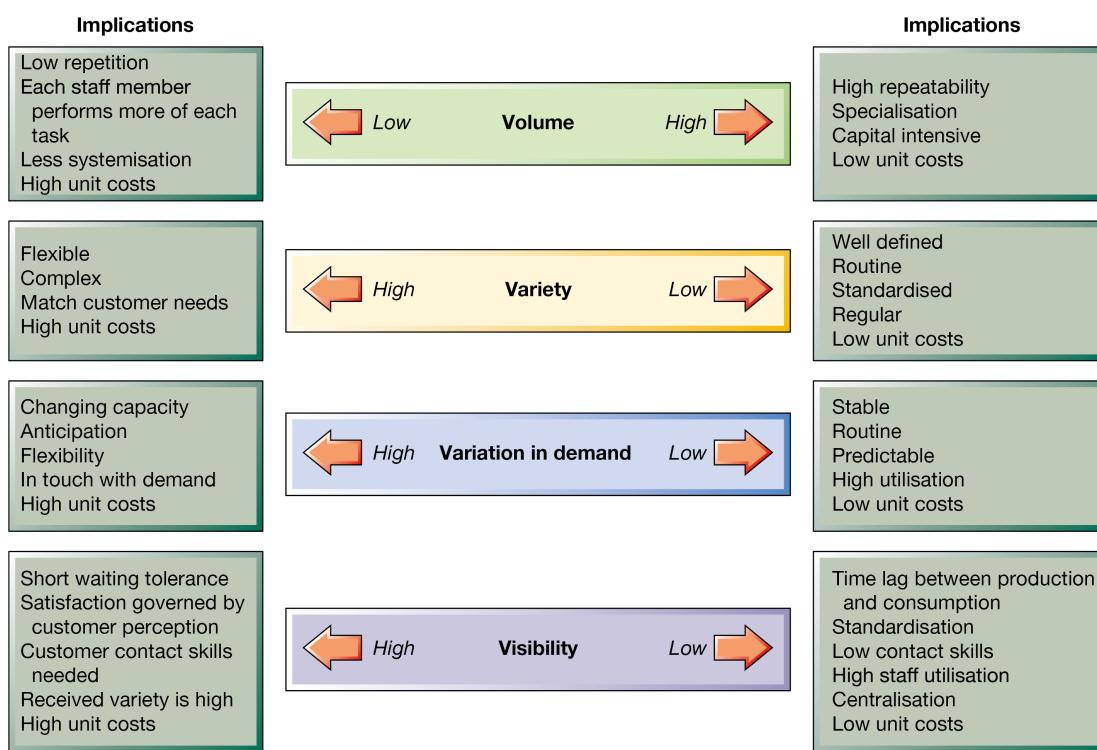
All four Vs have implications. Put simply, high volume, low variety, low variation and low customer contact all help to keep processing costs down. Conversely, low volume, high variety, high variation and high customer contact generally carry some kind of cost penalty. This is why the volume dimension is drawn with its ‘low’ end on the left, unlike the other dimensions, to keep all the ‘low cost’ implications on the right.

Operations principle: Operations and processes can (other things being equal) reduce their costs by increasing volume, reducing variety, reducing variation and reducing visibility.

The position of an operation on the four dimensions is determined by the demands of the market it is serving, although most operations have some discretion in moving themselves on the dimensions.

Figure 1.11 summarises the implications of such positioning.

Figure 1.11 A typology of operations and processes



The diagram indicates the following. Low volume has implications as low repetition, each staff member performs more of each task, less systemisation, and high unit costs. High volume implications are high repeatability, specialisation, capital intensive, and low unit costs. High variety has implications as

flexible, complex, match customer needs, and high unit costs. Low variety has implications as well defined, routine, standardised, regular, and low unit costs. High variation in demand implications are changing capacity, anticipation, flexibility, in touch with demand, and high unit costs. Low variation implications are stable, routine, predictable, high utilisation, and low unit costs. High visibility implications are short waiting tolerance, satisfaction governed by customer perception, customer contact skills needed, received variety is high, and high unit costs. Low visibility implications are time lag between production and consumption, standardisation, low contact skills, high staff utilisation, centralisation, and low unit costs.

Consider the 4Vs as you read the examples of operations in practice on the next screen.

Operations in practice: hospitality operations

Two very different hospitality operations

Ski Verbier Exclusive⁹



Source: Alexander Chizhenok/Shutterstock

It is the name of the company that gives it away; Ski Verbier Exclusive Ltd is a provider of ‘upmarket’ ski holidays in the Swiss winter sports resort of Verbier. With 23 years’ experience of organising holidays, it looks after luxury properties in the resort that are rented from their owners for letting to Ski Verbier Exclusive’s clients. The properties vary in size and the configuration of their rooms, but the flexibility to reconfigure the rooms to cater for the varying requirements of client groups is important. ‘*We are very careful to cultivate as good a relationship with the owners, as we are with our clients that use our holiday service*’, says Tom Avery, joint founder and director of the company. ‘*We have built the business on developing these personal relationships, which is why our clients come back to us year after year [40 per cent to 50 per cent of clients are returners]. We pride ourselves on the personal service that we give to every one of our clients; from the moment they begin planning their ski holiday, to the journey*

home. What counts is experience, expertise, obsessive eye for detail and the understated luxury of our chalets combined with our ability to customise client experience’.

Client requests can be anything from organising a special mountain picnic complete with igloos, to providing an ice sculpture of Kermit the Frog for a kids' party. The company's specialist staff have all lived and worked in Verbier and take care of all details of the trip well in advance, from organising airport transfers to booking a private ski instructor, from arranging private jet or helicopter flights to Verbier's local airport, to making lunch reservations in the best mountain restaurants. '*We cater for a small, but discerning market*', says Tom. '*Other companies may be bigger, but with us it's our personal service that clients remember*'. However, snow does not last all the year round. The company's busiest period is mid-December to mid-April, when all the properties are full. The rest of the year is quieter, but the company does offer summer vacations in some of its properties. These can be either self-catering, or with the full concierge service that clients get in the ski season. '*We adapt to clients' requirements*', says Tom. '*That is why the quality of our staff is so important. They have to be good at working with clients, be able to judge the type of relationship that is appropriate, and be committed to providing what makes a great holiday. That's why we put so much effort into recruiting, training and retaining our staff*'.

hotelF1¹⁰

Hotels are high-contact operations – they are staff-intensive and have to cope with a range of customers, each with a variety of needs and expectations. So, how can a highly successful chain of affordable hotels avoid the crippling costs of high customer contact? hotelF1, a subsidiary of the French Accor group, manages to offer outstanding value by adopting two principles not always associated with hotel operations – standardisation and an innovative use of technology.



Source: BSTAR IMAGES/Alamy Stock Photo

hotelF1 hotels are usually located close to the roads, junctions and cities that make them visible and accessible to prospective customers. The hotels themselves are built from state-of-the-art volumetric prefabrications. The prefabricated units are arranged in various configurations to suit the characteristics of each individual site. Rooms are 9 square metres in area, and are designed to be attractive, functional, comfortable and soundproof. Most important, they are designed to be easy to clean and maintain. All have the same fittings, including a double bed, an additional bunk-type bed, a wash basin, a storage area, a working table with seat, a wardrobe and a television set.

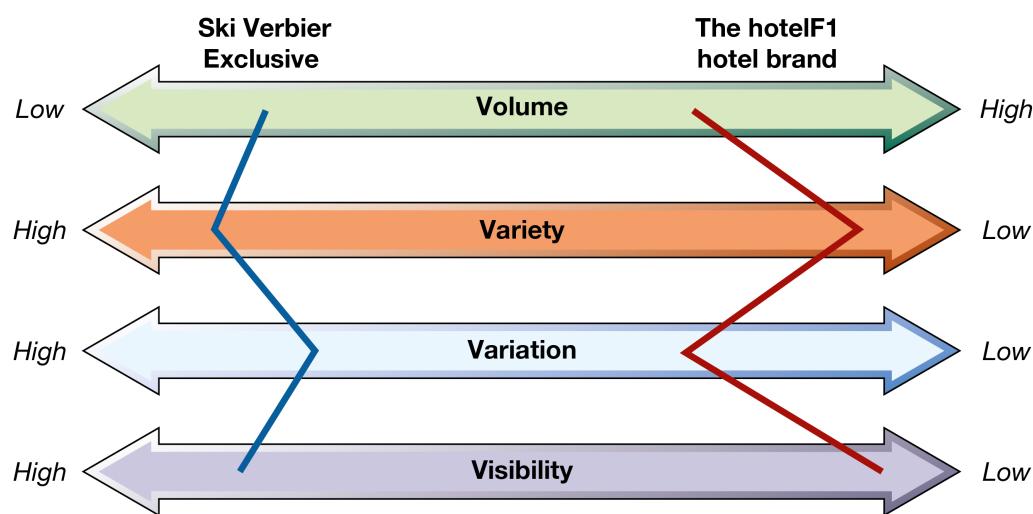
The reception of a hotelF1 hotel is staffed only from 6.30 am to 10.00 am and from 5.00 pm to 10.00 pm. Outside these times an automatic machine sells rooms to credit card users, provides access to the hotel, dispenses a security code for the room and even prints a receipt. Technology is also evident in the washrooms. Showers and toilets are automatically cleaned after each use by using nozzles and heating elements to spray the room with a disinfectant solution and dry it before it is used again. To keep things even simpler, hotelF1 hotels do not include a conventional restaurant, as they are usually located near existing ones. However, a continental breakfast is available, usually between 6.30 am and 10.00 am, and of course on a 'self-service' basis!

Worked example: the four Vs

Two very different hospitality operations positioned on the four Vs scales

Figure 1.12 illustrates the different positions on the dimensions of the Ski Verbier Exclusive operation and the hotelF1 hotel chain (see previous screen). Although both provide the same basic service in that they accommodate people, they are very different.

Figure 1.12 The four Vs profiles of two very different hospitality operations



It shows four two-way arrows showing volume, variety, variation and visibility. The extreme right of the arrow represents low and extreme left of the arrow represents high for variety variation and visibility and vice versa for volume. The ski verbier exclusive shows variety, variation and visibility as low high and for the hotel F1 hotel brand low respectively. The volume is low for the Ski Verbier Exclusive and the hotelF1 hotel brand as high.

Ski Verbier Exclusive provides luxurious and bespoke vacations for a relatively small segment of the ski holiday market. Its variety of services is almost infinite in the sense that customers can make individual requests in terms of food and entertainment. Variation is high with four months of 100 per cent occupancy, followed by a far quieter period. Customer contact, and therefore visibility, is also very high. All of this is very different from the hotelF1 branded hotels, whose customers usually stay one night, where the variety of services is strictly limited, and business and holiday customers use the hotel at different times, which limits variation. Most notably, though, customer contact is kept to a minimum.

Ski Verbier Exclusive has very high levels of service, which means it has relatively high costs. Its prices therefore are not cheap. Certainly not as cheap as hotelF1, which has arranged its operation in such a way as to provide a highly standardised service at minimal cost.

Here are two examples of how operations try to reduce the negative effects of having to cope with high levels of variety. Research each of them (there is plenty of information on the web) and answer the following questions:

1. What are the common features of these two examples?
2. What other examples of standardisation in transport operations can you think of?

Example 1 – The Mumbai Tiff Box Suppliers Association (search under dabbawallas) operates a service to transport home-cooked food from workers' homes to office locations in downtown Mumbai. Workers from residential districts must ride commuter trains to work. They can be conservative diners, who may also be constrained by cultural taboos on food handling. Their workers, known as dabbawallas, pick up the food in the morning in a regulation tin 'tiff box, deposit it at the office at lunchtime, and return it to the home in the afternoon. The dabbawallas take advantage of public transport to carry the tins, usually using otherwise underutilised capacity on commuter trains in the mid-morning and afternoon. Different colours and markings are used to indicate to the (sometimes illiterate) dabbawallas the process route for each tin.

Example 2 – Ports had to handle an infinite variety of ships and cargoes with widely different contents, sizes and weights, and protect them from weather and pilferage, while in transit or in storage. Then the transportation industries, in conjunction with the International Organization for Standardization (ISO), developed a standard shipping container design. Almost overnight the problems of security and weather protection were solved. Anyone wanting to ship goods in volume only had to seal them into a container and they could be signed over to the shipping company. Ports could standardise handling equipment and dispense with warehouses (containers could be stacked in the rain if required). Railways and trucking companies could develop trailers to accommodate the new containers.

(a) What are the common features of these two examples?

- As the question implies, both are methods of dealing with complexity. Both address an operations problem where there is, theoretically, an infinite **variety** of transformed resources to be processed into an infinite variety of products (different destinations). Anything that can control this complexity must have very significant operational advantages.
- Both also address what was a growing need at the time. The dabbawallas catered for the growing number of clerical workers who were needed to staff the huge Indian government bureaucracies. The ISO container was developed to cope with the growing volume of world trade.
- A third commonality is that both deal with the considerable complexity mentioned earlier. Quite simply, the services could not operate at anything like an affordable cost if variety was not controlled.
- Another similarity is that the return journey of the containers is simply a mirror image of the outward journey. The routing information on the containers allows simple routing and allows containers to be returned to the same place (far more important in the example of the Tiff Box Suppliers Association than in the ISO containers).
- Finally, both containers provide 'protection' for their cargoes. Containers can be left out in the rain and tiff boxes keep the food warm and protect it from contamination.

(b) What other examples of standardisation in transport operations can you think of?

The transport industries of the world often focus on standardisation so as to limit exposure to variety. For example, some courier services will limit the size of the package that they will carry. They may also provide a standardised package free to their customers to ensure standardisation of size, labelling, etc. Similarly, a passenger airline will transport multiples of basic units like people and ensure that cabin baggage conforms to a maximum size and weight. Attempting to take a surfboard, bicycle or llama (!) on a scheduled flight causes problems because of their non-standard nature.

Now take a short quiz to test your understanding of the process hierarchy.

Quiz 1.5 How do operations (and processes) differ?

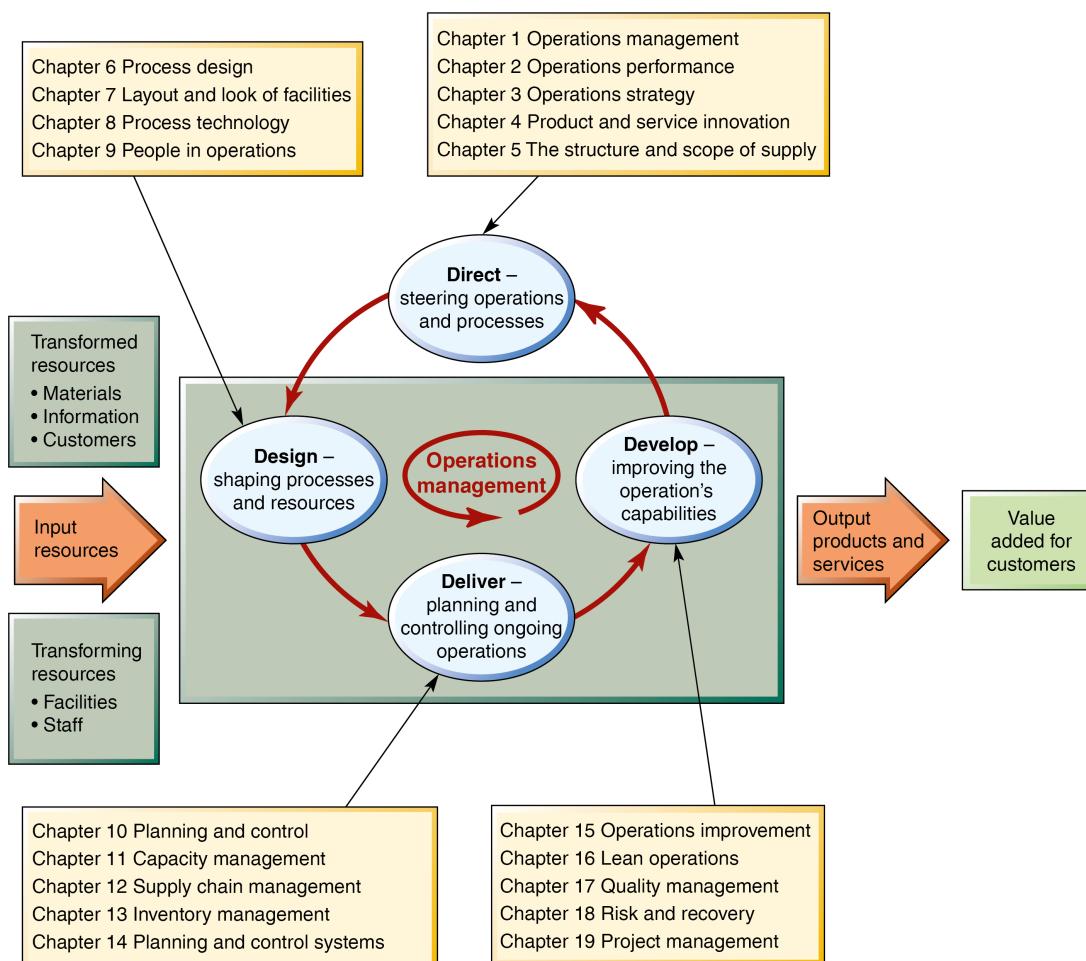
1.6 What do operations managers do?

1.6 Outline the role of the Operations Manager using an example.

The model of operations management

We can now combine two ideas to develop the model of operations and process management that will be used throughout *Operations Management*. The first is the idea that operations and the processes that make up both the operations and other business functions are transformation systems that take in inputs and use process resources to transform them into outputs. The second idea is that the resources both in an organisation's operations as a whole and in its individual processes need to be managed in terms of how they are directed, how they are designed, how delivery is planned and controlled, and how they are developed. **Figure 1.13** shows how these two ideas go together. We will use this model to examine the more important decisions that should be of interest to *all* managers of operations and processes.

Figure 1.13 A general model of operations management



The diagram is as follows. On the left is an arrow labelled input resources. Above the arrow is a box labelled transformed resources which lists materials, information, and customers. Below the arrow is a box labelled transforming resources which lists facilities and staff. The input resources arrow then directs to a box in the centre labelled operations management with a counter clockwise arrow that encompasses the operations management label. The operations management label and counter clockwise arrow is surrounded by four ovals labelled with descriptions as follows. Direct, steering operations and processes. The direct oval has an arrow pointing to a box showing the processes for direct being covered in the following chapters. Chapter 1, operations management. Chapter 2, operations performance. Chapter 3, operations strategy. Chapter 4, products and service innovation. Chapter 5, the structure and scope of supply. Design, shaping processes and resources. The design oval has an arrow pointing to a box showing the processes for design being covered in the following chapters. Chapter 6, process design. Chapter 7, layout and look of facilities. Chapter 8, process and technology. Chapter 9, people in operations. Deliver, planning and controlling ongoing operations. The deliver oval has an arrow pointing to a box showing the processes for deliver being covered in the following chapters. Chapter 10, planning and control. Chapter 11, capacity management. Chapter 12, supply chain management. Chapter 13,

inventory management. Chapter 14, planning and control systems. Develop, improving the operation's capabilities. The develop oval has an arrow pointing to a box showing the processes for develop being covered in the following chapters. Chapter 15, operations improvement. Chapter 16, lean operations. Chapter 17, quality management. Chapter 18, risk and recovery. Chapter 19, project management. Each oval has an arrow pointing counter clockwise to the next oval to create a circle. Outside of the box labelled operations management is an arrow pointing to the right labelled output products and services. This arrow points to a box labelled value added for customers.

The exact details of what operations managers do will, to some extent, depend on the way an organisation defines the boundaries of the function. Yet there are some general classes of activities that apply to all types of operations no matter how the operations function is defined.

Operations principle: Operations management activities can be grouped into four broad categories: directing the overall strategy of the operation, designing the operation's products resources and processes, planning and controlling delivery and developing performance.

We classify operations management activities under the four headings: direct, design, deliver and develop.

- Directing the overall strategy of the operation. A general understanding of operations and processes and their strategic purpose and performance, together with an appreciation of how strategic purpose is translated into reality, is a prerequisite to the detailed design of operations and process. This is treated in **Chapters 1 to 5**.
- Designing the operation's services, products and processes. Design is the activity of determining the physical form, shape and composition of operations and processes together with the services and products that they create. This is treated in **Chapters 6 to 9**.
- Planning and control process delivery. After being designed, the delivery of services and products from suppliers and through the total operation to customers must be planned and controlled. This is treated in **Chapters 10 to 14**.
- Development of process performance. Increasingly it is recognised that in operations, or any process, managers cannot simply deliver services and products routinely in the same way that they always have done. They have a responsibility to develop the capabilities of their processes to improve process performance. This is treated in **Chapters 15 to 19**.

Re-read the 'Operations in practice' examples on LEGOLAND and LEGO. What kinds of operations management activities at each of these operations might come under the four headings of direct, design, deliver and develop?

LEGOLAND

LEGOLAND's LEGO-themed attractions hotels and accommodation are aimed primarily at families with children aged 3 to 12. LEGOLAND has parks in seven countries and across three continents. The first park opened over 60 years ago, near the LEGO factory in Billund, Denmark. Location is important. For example, LEGOLAND Deutschland is located in Bavaria close to Switzerland and Austria, all markets with a significant Lego following. All LEGOLAND parks are operated by the UK-based Merlin Entertainments, which also operates other branded attractions in the United Kingdom, Italy and Germany, such as Madame Tussauds, The London Eye, Warwick Castle and Alton Towers. What all of these have in common is that they provide their visitors with an 'experience'. Every stage of each attraction that customers (usually referred to as 'guests') move through has to be designed to create an intense or immersive experience centred on theming around movie or television characters, or in the case of LEGOLAND, LEGO intellectual property. The individual attractions in theme parks require considerable investment, often using sophisticated technology. Maintaining the utilisation of these attractions means trying to manage the flow of guests around the park so that they are queueing for as little time as possible. However, public holidays, seasons and weather will all impact on the number of guests wanting to visit each park. But however busy a park is, the quality of its guests' satisfaction with the experience is an important part of LEGOLAND'S operations management. What it calls its 'Guest Obsession' with creating smooth and memorable experiences for its guests includes regularly monitoring guest satisfaction scores.

LEGO

The LEGO Group is one of the leading manufacturers of play materials. LEGO bricks are manufactured at the Group's factories, located to be near its key markets in Europe and the United States. The company's success is founded on a deceptively simple idea. One LEGO brick is unremarkable but put one or two or more together and possibilities start to emerge. For example, there are more than 915 million possible ways of arranging six standard four-by-two bricks. With all the elements, colours and decorations in the LEGO range, the total number of combinations becomes very large indeed. Yet however many bricks you assemble, and irrespective of what colour or set they are from, they will always fit together perfectly because they are made to very high levels of precision and quality. The company's motto is 'Only the best is good enough'. At the Billund operation, 60 tons of plastic is processed every 24 hours, with its moulding machines supplied by a complex arrangement of tubes. This stage is particularly important, because every LEGO piece must be made with tolerances as small as 10 micrometres. The moulds used by these machines are expensive, and each element requires its own mould. Robot trolleys travel between the machines, picking up boxes and leaving empty ones, an investment in automation that means that few people are required. In the packaging process the LEGO sets take their final form. The system knows exactly how much each packed box should weigh at any stage and any deviation sets off an alarm. Quality assurance staff perform frequent inspections and tests to make sure the toys are robust and safe. For every 1 million LEGO elements, only about 18 (that's 0.00002 percent) fail to pass the tests. In addition, throughout the process, the company tries to achieve high levels of environmental sustainability. Plastic is extensively recycled in the factory.

This is not an exhaustive list, and is a bit speculative, but typical operations-related decisions could include the following:

Direct	Design	Deliver	Develop
Competitive priorities (quality, freshness, product innovation and social responsibility)	Store layout and design Customer flow pattern Human resource policies	Store staffing levels Opening times Ingredient ordering levels Inventory levels (low because of freshness policy)	Quality of service standards Quality monitoring (they use 'mystery shopper' systems) Reward schemes
Store location Store capacity Operating structure (no central kitchen)		Supplier selection and liaison	

The values under the four columns are as follows: direct: competitive priorities such as quality, freshness, product innovation and social responsibility, store location, store capacity, operating structure such as no central kitchen; design: store layout and design, customer flow pattern, human resource policies; deliver: store staffing levels, opening time, ingredient ordering levels, inventory levels are low because of freshness policy, supplier selection and liaison; and develop: quality of service standards, quality monitoring, where they use mystery shopper systems, reward schemes.

Operations management impacts social–environmental sustainability

Earlier, we identified the increasing importance of social–environmental sustainability on operations management practice. It is worth re-emphasising that many of the activities of operations managers have a huge impact on the natural environment, society broadly, and specific stakeholder groups such as the operation's staff, suppliers, investors and regulators (where relevant). Social responsibility is important to operations managers because of the profound impact operations practice can have on the environment and society at large, and conversely how operations practice is shaped by social–environmental considerations. Environmental sustainability means meeting the needs of the present without compromising the ability of future generations to meet their own needs. Put more directly, it means the extent to which business activity negatively impacts on the natural environment. It is clearly an important issue, not only because of the obvious impact on the immediate environment of hazardous waste, air, and even noise, pollution, but also because of the less obvious, but potentially far more damaging issues around global warming. The example of operations in practice on the next screen focuses on how Fjällräven's outdoor clothing and equipment products were voted the most sustainable in their field.

Operations principle: Operations management activities will have a significant effect on the social, ethical and environmental performance of any type of enterprise.

Operations in practice: Fjällräven

Fjällräven products are voted the most sustainable in their field¹¹

Developing a reputation for sustainability does not happen overnight. When Fjällräven's outdoor clothing and equipment products were voted the most sustainable in their field by Europe's largest brand study on sustainability, Sweden's Sustainable Brand Index, it was the result of many years dedication to sustainable-based decisions in design, testing, material choices, supply chain and production, right through to 'repairability' and what happens at the end of a product's life. Founded in 1960 by Åke Nordin in Örnsköldsvik, Sweden, the company was always committed to quality, functional and durable design, and in particular, acting responsibly towards people, animals and nature.



Source: kovop58/Shutterstock

So, Fjällräven prioritise the use of recycled, organic and renewable materials by applying the Higg Index criteria, an approach developed by the Sustainable Apparel Coalition that enables operations in the apparel industries to measure their sustainability performance. For example, the company produced a special edition of one of its most popular products, the Kånken backpack, which is made from 11

recycled plastic bottles. It is also dyed using the ‘SpinDye’ process, which uses much less water than traditional dying processes. Avoiding waste is important to Fjällräven. The type and amount of a material used is a key concern during the design process. The company’s policy on material selection is ‘Why use a raw material when a recycled one is available and offers the same quality?’ It checks whether the amount of a material can be reduced by adapting the cut and fit of a garment or product to reduce waste. Moreover, looking to the future when garment recycling is more prevalent, the company tries to use just one or two materials in each product to make future recycling easier.

However, the company does recognise that achieving its sustainability goals is not always easy, and that compromises are sometimes necessary. ‘We sometimes have to say “No” when we want to say “Yes”’, they say. All materials are evaluated for their efficiency, functional qualities, chemical composition and the amount needed. Its ‘Preferred Materials And Fibres List’ grades materials in terms of their impact on the environment, and is constantly updated to take account of new research and new materials. However, it doesn’t matter how sustainable a material is if it does not do its job of keeping users warm and dry. Any material’s functionality and efficiency has to be balanced with its environmental impact. Underlying the company’s sustainability efforts is a long-term view of innovation and improvement. ‘We have made, and will continue to make, mistakes’ they say. ‘But we try to learn from them [and] we aim to innovate and adapt. We’re not ones to settle. We never sit back and relax thinking what we’re doing now is good enough. At Fjällräven, the term “room for improvement” is ingrained in all of us’.

To be a great operations manager you need to...

So, you are considering a career in operations management, and you want to know, ‘Is it for you?’ What skills and personal qualities will you need to make a success of the job as well as enjoying yourself? Well, the first thing to recognise is that there are many different roles encompassed within the general category of ‘operations management’. Someone who makes a great risk control system designer in an investment bank may not thrive as a site manager in a copper mine. A video game project manager has a different set of day-to-day tasks when compared with a purchasing manager for a hospital. So, the first skill you need is to understand the range of operations-related responsibilities that exist in various industries; and there is no better way to do this than by reading this text! However, there are also some generic skills. Here are some of them:

- ***Enjoys getting things done*** – Operations management is about doing things and finishing tasks. It means hitting deadlines and not letting down customers, whether they are internal or external.
- ***Understands customer needs*** – Operations management is about fully understanding what ‘value’ means for customers. It means ‘putting yourself in the customer’s place’; knowing how to ensure that your services or products make the customer’s life better.
- ***Places a high value on ethical, socially and environmentally sensitive decision-making*** – Given the potential impact of operations decisions, all operations practice needs to be set in the context of wider societal responsibilities.
- ***Communicates and motivates*** – Operations management is about directing resources to produce services or products in an efficient and effective manner. This means articulating what is required and encouraging people to do it. Interpersonal skills are vital. Operations managers must be ‘people people’.
- ***Learns all the time*** – Every time an operations manager initiates an action (of any kind) there is an opportunity to learn from the result. Without learning there can be no improvement, and improvement is an imperative for all operations.
- ***Committed to innovation*** – Operations management is always seeking to do things better. This means creating new ways of doing things, being creative, imaginative and (sometimes) unconventional.
- ***Knows their contribution*** – Operations management may be the central function in any organisation, but it is not the only one. It is important that operations managers know how they can contribute to the effective working of other functions.

- ***Capable of analysis*** – Operations management is about making decisions. Each decision needs to be evaluated (sometimes with very little time). This involves looking at both the quantitative and the qualitative aspects of the decision. Operations managers do not necessarily have to be mathematical geniuses, but they should not be afraid of numbers.
- ***Keeps cool under pressure*** – Operations managers often work in pressured situations. They need to be able to remain calm no matter what problems occur.

Now take a short quiz to test your understanding of what operations managers do.

Quiz 1.6 What do operations managers do?

1.7 Case study: Kaston-Trenton Service (KTS)

1.7 Apply key concepts of operations management to a case study.

Read the case study then answer the questions that follow.

Kaston-Trenton Service

Kaston-Trenton Service (KTS) is a domestic heating boiler maintenance company, based in the eastern part of the United Kingdom.

Founded in the 1960s by plumber Christopher Trenton, it had grown substantially and was now run jointly by Christopher's two children, Ros, who looked after all marketing, sales and finance, and Mark, who looked after operations and supply issues. The company initially offered maintenance and repair services to domestic (household) customers with gas- or oil-burning boilers and expanded into offering similar services to business customers. Within the last two years KTS had also moved beyond simply servicing systems, to designing and installing HVAC (heating, ventilation and air conditioning) systems for business customers.

'Expanding into the design and installation business was something of a gamble,' according to Ros. 'At the time, the B2B [business to business] part of our work was clearly showing more growth potential than our traditional domestic business and servicing business customers was also more profitable. So far, the installation venture has had mixed success. The jobs that we have done have been successful and our new customers very satisfied, but so far we have lost money on them. Partly, this is because we have had to invest in extra workshop space at our headquarters and employ a system designer, who is relatively expensive (but good) and only partly utilised at the moment. Hopefully, profitability will improve as the volume of installation jobs increases'.

Table 1.5 shows the number of contracts and the revenue from domestic servicing, business servicing, and the design and installation businesses, both for the previous year and the forecast for the current year of operation (all figures as of end Qtr 3). The profitability of the three offerings was difficult to

determine exactly, but Ros and Mark were satisfied with the contribution of domestic boiler servicing, and especially of the business boiler servicing activities.

Table 1.5 The number of contracts and the revenue from the three activities

Activity	Previous year		Current year (forecast)	
	Number of contracts	Revenue (£000)	Number of contracts	Revenue (£000)
Domestic boiler servicing	7331	1408	9700	1930
Business boiler servicing	972	699	1354	1116
Design and installation	3	231	6	509
Total		2338		3555

KTS services

Domestic boiler servicing was seen by Ros and Mark as a ‘cash cow’, generating revenues at a fairly steady rate. There were many different makes of boiler installed, but KTS only contracted to service the most common that accounted for about 60 per cent of the installed base. Less common boilers were often serviced by the manufacturers that supplied them. Domestic servicing accounted for by far the most individual contracts for KTS, with customers spread over most of the East of England. Around 95 per cent of customers renewed their contracts each year, which was seen as a testament both to their quality of service and the company’s keen pricing. ‘*It’s a price sensitive market*’, said Ros. ‘*We have to be competitive, but that’s not all that counts. Most visits by our technician are routine yearly services, but about 20 per cent of visits are ‘call-outs’ with varying degrees of urgency. If a home boiler stops working on a winter weekend, the householder obviously expects us to respond quickly, and we try our best to get a technician to them within 4 or 5 hours. If it’s simply a non-urgent controller fault in summer, we would probably agree a mutually convenient time to visit within a couple of days. Actually, the idea of a “mutually convenient time” is important in this market. Householders often have to make special arrangements to be in, so we have to be flexible in arranging appointments and absolutely*

reliable in being there on time. Although call-outs are only 20 per cent of visits, they cause the majority of problems because both their timing and duration are unpredictable. Also, customers are sensitised to boiler performance following an emergency call-out. What we call the “robustness of the repair” has to be high. Once it’s fixed, it should stay fixed, at least for a reasonable length of time’.

Business boiler servicing was different. Most customers' systems had been, to some extent, customised, so the variety of technical faults that the technicians had to cope with was higher. Also, a somewhat higher proportion of visits were call-outs (between 25 and 30 per cent) so demand was slightly less predictable. The real difference between domestic and business customers, according to Mark, was the nature of the contact between KTS technicians and customers. '*Business customers want to be involved in knowing the best way to use their systems. They want advice, and they want to know what you are doing. So, for example, if you install an update to the system control software, they usually want to be informed. They also either keep a servicing log themselves, or ask us to report on measures such as boiler efficiency, time between repairs, downtime due to failure or servicing (particularly important) and so on. Call-out response time is particularly important for them, but because there is usually someone always on their premises, it is easier to arrange a time to call for regular servicing’.*

Both Ros and Mark were disappointed that the design and installation business had been slow to take off. The one system designer they had hired was proving an asset, and two of their technicians from the business servicing side of the operation had been moved over to installation work and were proving successful. '*It's a tight team of three at the moment*', said Mark, '*and that should give us enough capacity for the remainder of the year. But we will eventually need to recruit more technicians as business (hopefully) builds up*'. The extra workshop space that the firm had rented (on the same site) and some new equipment had allowed the design and installation team to adapt and customise boiler and control systems to suit individual customers' requirements. '*Many installers are owned by boiler manufacturers and can be guilty of pushing a standard solution on customers*' said Mark. '*With us, every system is customised to each customer's needs*'.

KTS organisation

A small administrative office of four people reported directly to Ros and Mark and helped manage accounting, HR, invoicing, contract maintenance and purchasing activities. The office was adjacent to a workshop space shared by the domestic and business boiler technicians. KTS employed 42 technicians in total. Nominally 26 of these worked on domestic boiler servicing and repair, and 16 on business boiler servicing and repair, yet there was some flexibility between the two groups. '*We are lucky that our*

technicians are usually reasonable about helping each other out', said Mark. 'It is generally easier for the technicians used to serving business customers to serve domestic ones. They are not always as efficient as those used to domestic customers, but their customer-facing skills are usually better. Domestic boiler technicians do not always appreciate that business customers want more reassurance and information generally. Also, it is important for business customers to receive a full technical report within a couple of days of a visit. Domestic technicians are not used to doing that'.

Improving service efficiency

Although both Ros and Mark were broadly happy with the way the business was developing, Mark in particular felt that they could be more efficient in how they organised themselves. '*Our costs have been increasing more or less in line with revenue growth, but we should really be starting to get some economies of scale. We need to improve our productivity, and I think we can achieve this by reducing waste. For example, we have found that our technicians can waste up to 30 per cent of their time on non-value-adding activities, such as form-filling or retrieving technical information'*'.

Mark's solution was to tackle waste in a number of ways:

- **Establish key performance measures (KPIs) and simple metrics** – Performance measures must be clearly explained so that technicians understand the objectives that underlie their targets in terms of availability, utilisation and efficiency.
- **Better forecasting** – Demand was forecast only in the simplest terms. Historical data to account for seasonality had not been used, nor had obvious factors, such as weather, been monitored.
- **Slicker processes** – Administrative and other processes had been developed 'organically' with little consideration of efficiency.
- **Better dispatching** – Dispatching (the allocation of jobs to individual technicians) was usually done on a simple 'first come, first served' basis without taking the efficient use of technicians' time into account. It was believed that both travel time and 'time to uptime' could be improved by better allocation of jobs.
- **Better training** – In the previous two years, three technicians had retired, one had been dismissed and two had left for other jobs. Mark had experienced difficulty in replacing them with experienced people. It had become clear that it would become more important to hire

inexperienced people and train them. In Mark's words, '*to get smart people with the right attitude and problem-solving skills, who don't mind get their hands dirty, and give them the technical skills*'.

In addition to thinking about how best to improve efficiency, future market growth was also a concern. Two developments were occupying Ros and Mark's thoughts, one in the short to medium term, the other in the longer term.

Future growth – short to medium term

Demand had been growing steadily, largely by KTS winning business from smaller competitors. But Mark wondered whether the nature of what customers would want was changing. An opportunity had been suggested by one of KTS's oldest business customers. They had been approached by another HVAC company that had asked if they would be interested in a 'total' service, where the company would both supply and operate a new heating system. In effect they were asking if KTS's customer would totally outsource their heating to them. It was an idea that Mark was intrigued by. '*I have heard about this type of deal before, but mainly for large businesses and offered by facilities management companies. It can involve companies like ours actually buying the heating system, installing it and taking responsibility for managing not just the system itself, but actually how much energy is used. Exactly how it might work will, I guess, depend on the terms of the contract. Does the customer pay an amount per unit of energy used (perhaps linked to the wholesale price of energy)? Or does the customer simply pay a fixed amount for agreed operating characteristics, such as maintaining a particular temperature range? We would have to think carefully about the implications for us before offering such a service. The customer who told us about the approach does not want to desert us, but who knows what they might do in the future*'.

The future – longer term

According to the Climate Change Committee (CCC), an independent advisory body that assisted the UK government in reaching required carbon levels, meeting the United Kingdom's target to reduce emissions would require reducing domestic emissions by at least 3 per cent per year – a challenging target. This would mean that within a few years it could become illegal to install gas boilers in new-build homes. One possible future that was discussed in the industry was a general move towards a hydrogen network (burning hydrogen produces no emissions and creates only water vapour and heat). However, a more likely future would probably involve combining different renewable technologies to provide low-

carbon heat. The lowest-cost, long-term solution could be to replace gas and oil boilers with hydrogen alternatives alongside electric heating generated from renewable sources such as air source or ground source heat pumps, which use small amounts of electricity to draw natural heat from either the air or the ground. But, to make heat pumps effective, all existing and new-build homes would need to be made energy efficient by using far better levels of insulation.

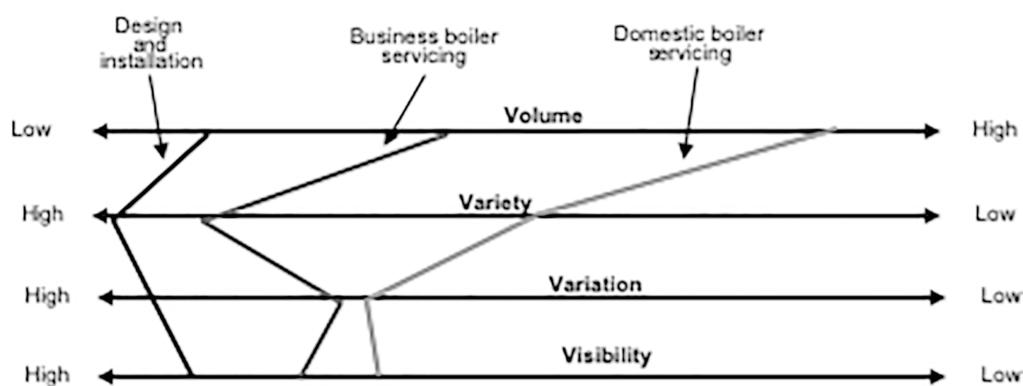
Ros thought that these developments could prove far more challenging for KTS. '*Both Mark and I had assumed that we would be in this business for at least another 20 to 30 years. We both have families, so the long-term future of the business is obviously important to us. New heating technologies and fuels pose both opportunities and threats (yes, I've done an MBA!) for us. Reducing fossil fuel consumption will definitely mean that we have to change what we do. And some aspects of demand may reduce. For example, ground source systems require little maintenance. But if there is going to be an upswing in the installation market, we need to be on top of it'*'.

Now, think about the following questions before revealing each answer.

How would you position each of KTS's services on the four Vs dimensions of volume, variety, variation and visibility?

The point of the four Vs analysis is not primarily to compare very different offerings but to compare similar, but different things. The three types of offering are shown below. While the design and installation offering is very much at the left side of the spectra (which usually means that creating this type of service has a relatively high cost), the other two services are positioned more to the right (cheaper to produce). However, all KTS offerings are relatively high variation (because of the unexpected nature of some servicing) and especially high visibility (because the service has to be performed at the customer's premises).

4 V's analysis for KTS



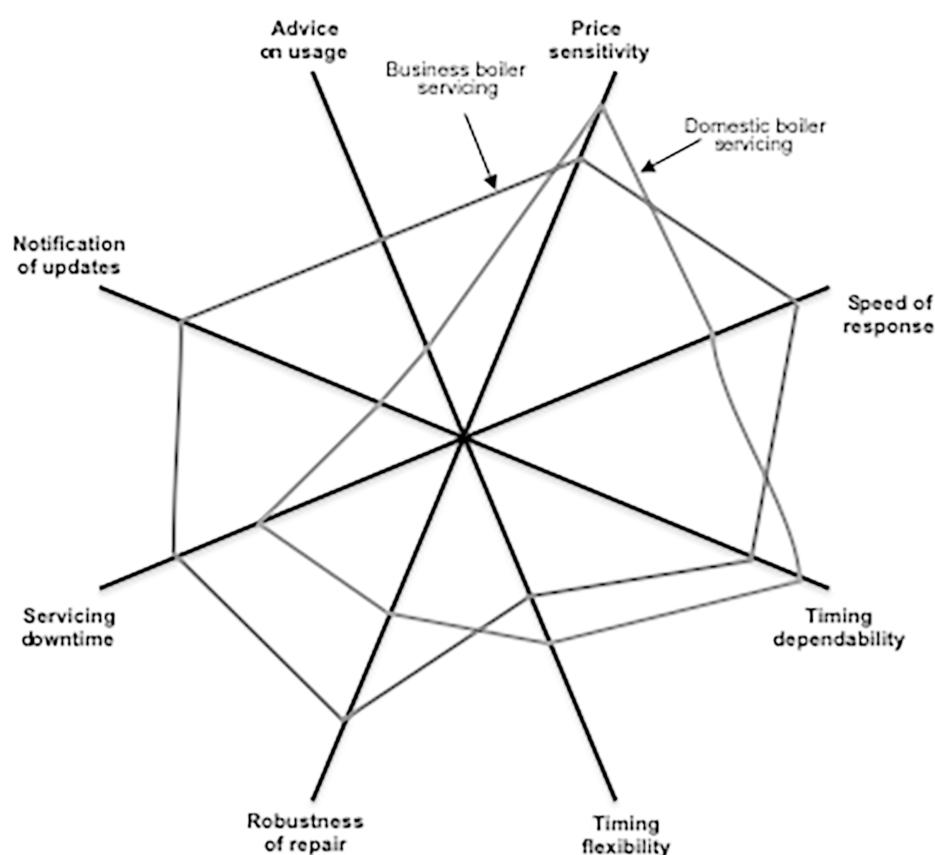
The four V's are volume, variety, variation and visibility. It depicts the design and installation, business boiler servicing and domestic boiler servicing. Design and installation has low volume,

very low variety, low variation and low visibility. Business boiler servicing has medium volume, low variety, low to medium variation and low to medium visibility. Domestic boiler servicing has high volume, medium variety, low to medium variation and low to medium visibility.

What aspects of performance are important for KTS to win more servicing business? How would you use a polar diagram to show this?

There are many ways to answer this question. Perhaps most useful is to use a polar diagram similar to the one shown here. The types of performance are obviously chosen to suit the circumstances, but each is mentioned in the case.

An analysis of the performance requirements of KTS's two types of servicing customers



The illustration depicted with eight lines started from a common point at the centre. The eight lines are labelled, advice on usage, price sensitivity, speed of response, timing dependability, timing flexibility, robustness of repair, servicing downtime and notification of updates. Business boiler servicing has high price sensitivity, high speed of response, high timing, dependability, low timing flexibility, high robustness of repair, high servicing downtime, high notification of updates and medium advice on usage. Domestic boiler servicing has very high price sensitivity, medium speed of response, very high timing, dependability, medium timing flexibility, low robustness of repair, medium servicing downtime, very low notification of updates and very low advice on usage.

How would you evaluate the potential of offering a 'total' service like the KTS customer had been offered?

The total service is clearly a broader service with changes in the balance of risk between the customer and KTS. It demonstrates that the concept of 'servitisation' is not something that applies only to physical goods producers. Here is a service provider who is also considering taking over responsibility for a 'total' service in term of what the service provides. So instead of selling 'the servicing of boilers', KTS would move to selling 'the continuity of heating'. Some points that could be raised include:

- Servitisation often involves new and ill-understood risks. These include the risks inherent in diverting financial resources away from other activities.
- Servitisation involves significant cultural issues.
- Servitisation can expose costing deficiencies. In particular, life cycle costing was seen as a very approximate activity that would have to be improved significantly if servitisation was to avoid unacceptable risks.
- Servitisation redefines risk management. There can be strains regarding the unquantified but probably significant increase in risk in taking over activities previously performed by customers. It may be that at some point the marginal extra risk incurred will outweigh the marginal benefits of increased profit potential.
- Servitisation will impact technology strategy. The value of new but less reliable technologies could decrease when servitisation involves taking on more explicit risk.
- Servitisation poses new opportunities for knowledge transfer mechanisms. Generating knowledge is a key task, especially for front-line staff, yet most companies were dissatisfied with their ability to feed back this knowledge, especially into product design activities.

What should KTS be doing to prepare for possible longer-term changes in their industry?

The nature of the future of both domestic and business heating is likely to be affected by increased measures to limit carbon levels in order to meet the UK's target to reduce emissions (as with most other European countries). What is uncertain is the speed and extent of any legislative changes. You may have raised other considerations when thinking about what could be done in advance of any changes.

Responsible operations: Chapter 1

There is a two-way relationship between operations management and corporate social responsibility (CSR, a term we will explain in the next chapter). Operations management practice can significantly affect such issues, and sensitivity to these issues has increasingly shaped what is regarded as good operations practice. One can think about this two-way relationship at different levels. Think about the pollution-causing disasters that make the headlines periodically. They seem to be the result of a whole variety of causes – oil tankers run aground, nuclear waste is misclassified, chemicals leak into a river, or polluting gas clouds drifting over industrial towns. But in fact, they all have something in common. They were all the result of an operations-based failure. Somehow operations procedures were inadequate. Less dramatic in the short term, but perhaps more important in the long term, is the environmental impact of products that cannot be recycled and processes that consume large amounts of energy.

Just as important is the question of why organisations are increasingly careful to behave responsibly.

One piece of research suggests that there are three reasons to engage in CSR activities:¹²

- The first is surprisingly altruistic. Some CSR focuses purely on philanthropy, where activities are not aimed explicitly at producing profits or specifically improve the operation's performance. For example, many operations donate funds or equipment to civic organisations, promote community enterprises and encourage employee volunteering.
- The second reason is more directly related to operations management. It involves activities that not only provide CSR benefits, but also support operations objectives by saving costs and/or enhancing revenue. Here CSR and the conventional concerns of operations management coincide. For example, such activities could include reducing waste or emissions (which may also reduce costs). In fact, many of operations management's environmental issues are concerned with waste. Operations management decisions in product and service design impact the utilisation of materials as well as long-term recyclability. Process design influences the proportion of energy, materials and labour that is wasted. Planning and control affects material wastage (packaging being wasted by mistakes in purchasing, for example) as well as energy and labour wastage. Improving working conditions for staff, or investing in training and education, may both enhance productivity and staff retention, as well as enhancing an organisation's reputation.
- The third reason is to explore new forms of business specifically to address social or environmental challenges, but at the same time provide business benefits. For example, in its

Philippines operation, Unilever, the household and food brands company, supports women store-owners, while at the same time increasing its sales. Although these stores play an important role in many communities, they rarely have had the training or development necessary for growth, nor do they have access to business skills and information. The project, which helps the store-owning entrepreneurs gain the skills and knowledge to grow, both helps them boost their businesses and boosts the sales of Unilever brands.

Critical commentary: Chapter 1

The central idea in this introductory chapter is that all organisations have operations processes that create and deliver services and products, and all these processes are essentially similar. However, some believe that by even trying to characterise processes in this way (perhaps even by calling them ‘processes’) one loses or distorts their nature and depersonalises or takes the ‘humanity’ out of the way in which we think of the organisation. This point is often raised in not-for-profit organisations, especially by ‘professional’ staff. For example, the head of one European ‘medical association’ (a doctors’ trade union) criticised hospital authorities for expecting a ‘sausage factory service based on productivity targets’.¹³ No matter how similar they appear on paper, it is argued, a hospital can never be viewed in the same way as a factory. Even in commercial businesses, professionals, such as creative staff, often express discomfort at their expertise being described as a ‘process’.

Revise: Chapter 1

1.1 What is operations management?

- Operations management is the activity of managing the resources that are devoted to the creation and delivery of service and products. It is one of the core functions of any business, although it may not be called ‘operations management’ in some industries.
- Operations management is concerned with managing processes. And all processes have internal customers and suppliers. But all management functions also have processes. Therefore, operations management has relevance for all managers.

1.2 Why is operations management important in all types of organisations?

- Operations management uses the organisation’s resources to create outputs that fulfil defined market requirements. This is the fundamental activity of any type of enterprise.
- Operations management is increasingly important because today’s changing business environment requires new thinking from operations managers, especially in the areas of new technology, supply networks and environmental sustainability.

1.3 What is the input–transformation–output process?

- All operations can be modelled as input–transformation–output processes. They all have inputs of transforming resources, which are usually divided into ‘facilities’ and ‘staff’, and transformed resources, which are some mixture of materials, information and customers.
- Most operations create and deliver a combination of services and products, rather than being a ‘pure’ service or product operation.
- All operations can be positioned by their intangibility, heterogeneity, inseparability, and perishability characteristics.

1.4 What is the process hierarchy?

- All operations are part of a larger supply network which, through the individual contributions of each operation, satisfies end-customer requirements.

- All operations are made up of processes that form a network of internal customer–supplier relationships within the operation.

1.5 How do operations (and processes) differ?

- Operations and processes differ in terms of the volume of their outputs, the variety of outputs, the variation in demand for their outputs and the degree of ‘visibility’ they have.
- High volume, low variety, low variation and low customer ‘visibility’ are usually associated with low cost.

1.6 What do operations managers do?

- Responsibilities can be classed in four categories – direct, design, deliver and develop.
- Increasingly, operations managers have a responsibility for an operation’s environmental performance.

Selected further reading: Chapter 1

1. Anupindi, R., Chopra, S., Deshmukh, S.D., Vam Mieghem, J.A. and Zemel, E. (2013) *Managing Business Process Flows*, 3rd edn, Pearson, Harlow.
2. *Takes a ‘process’ view of operations, it’s mathematical but rewarding.*
3. Barnes, D. (2018) *Operations Management: An International Perspective*, Palgrave, London.
4. *A text that is similar in outlook to this one, but with more of a (useful) international perspective.*
5. Chase, R.B. and Jacobs, F.R. (2017) *Operations and Supply Chain Management*, McGraw-Hill, New York.
6. *There are many good general textbooks on operations management. This takes a supply chain view, although written very much for an American audience.*
7. Hall, J.M. and Johnson, M.E. (2009) When should a process be art, not science?, *Harvard Business Review*, March.
8. *One of the few articles that looks at the boundaries of conventional process theory.*
9. Hammer, M. and Stanton, S. (1999) How process enterprises really work, *Harvard Business Review*, November–December.
10. *Hammer is one of the gurus of process design. This paper is typical of his approach.*
11. Holweg, M., Davies, J., De Meyer, A., Lawson, B. and Schmenner, R. (2018) *Process Theory: The Principles of Operations Management*, Oxford University Press.
12. *As the title implies, this is a book about theory. It is unapologetically academic but does contain some useful ideas.*
13. Johnston, R. Shulver, M., Slack, N. and Clark, G. (2021) *Service Operations Management*, 5th edn, Pearson, Harlow.
14. *What can we say! A great treatment of service operations from the same stable as this text.*
15. Slack, N. (2017) *The Operations Advantage*, Kogan Page, London.
16. *More of a practical treatment of how operations management can contribute to strategic success. Aimed at practising managers.*
17. Slack, N. and Lewis, M.A. (2020) *Operations Strategy*, 6th edn, Pearson, Harlow.
18. *A more strategic coverage of operations management.*

