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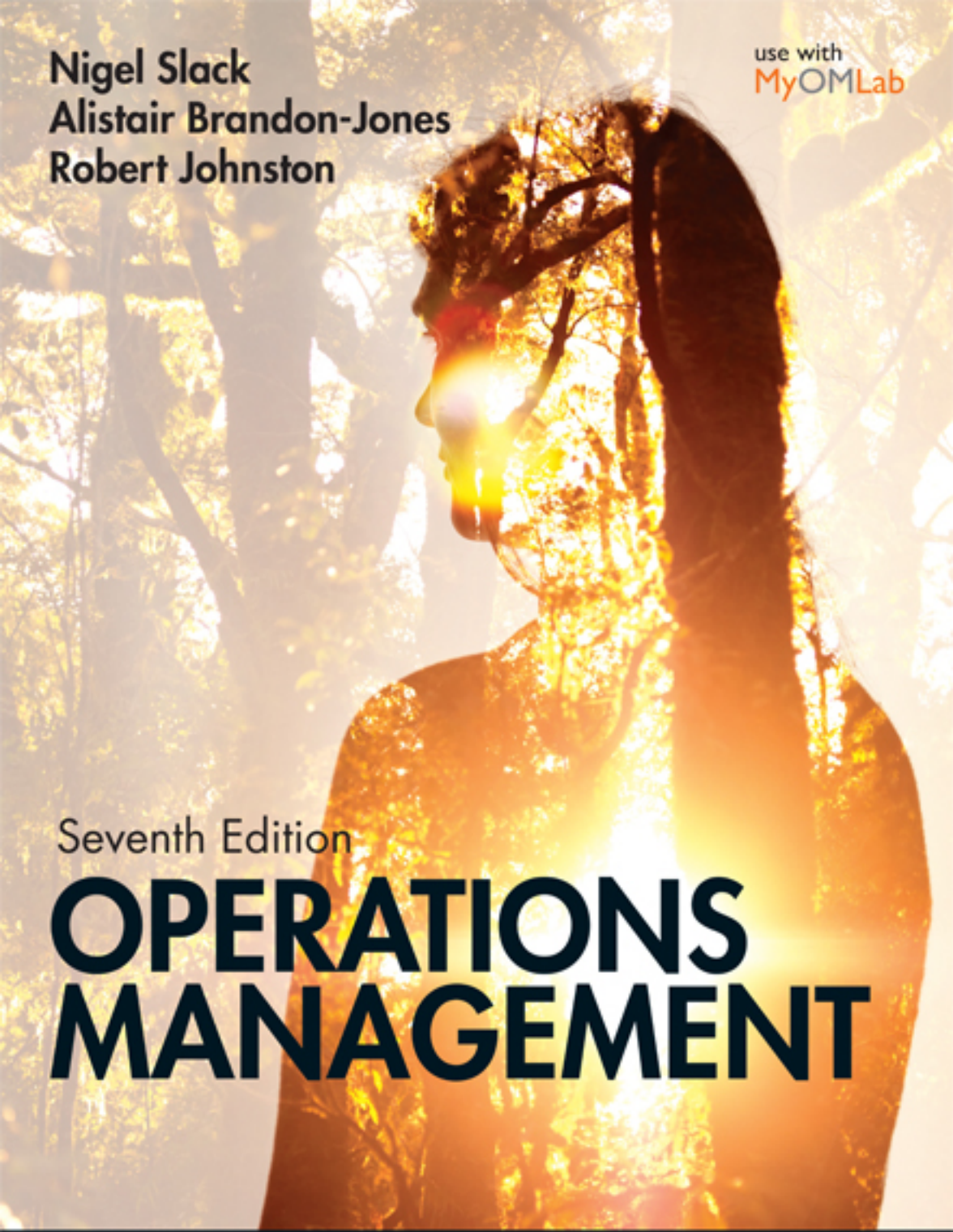

Seventh Edition

OPERATIONS MANAGEMENT

ALWAYS LEARNING

PEARSON

10 The nature of planning and control

Key questions

- What is planning and control?
- What is the difference between planning and control?
- How do supply and demand affect planning and control
- What are the activities of planning and control?

INTRODUCTION

The design of an operation determines the resources with which it creates its services and products, but the operation then has to deliver those services and products on an ongoing basis. And central to an operation's ability to deliver is the way it plans its activities and controls them so that customers' demands are satisfied. This chapter introduces and provides an overview of some of the principles and methods of planning and control. Later chapters in this part of the book develop some specific issues that are vital to an operation delivering its services and products. These issues start with managing capacity and move through managing inventory, providing an overview of supply chain management and looking at how enterprise resources planning (ERP) manages the information that ensures effective delivery. We then examine how 'lean' philosophy has influenced operations practice before examining the special case of project management and finally the role that quality management plays in delivering appropriate services and products. But whatever aspect of delivery is being examined, they can all be viewed as representing the reconciliation of supply with demand (*see* Fig. 10.1).

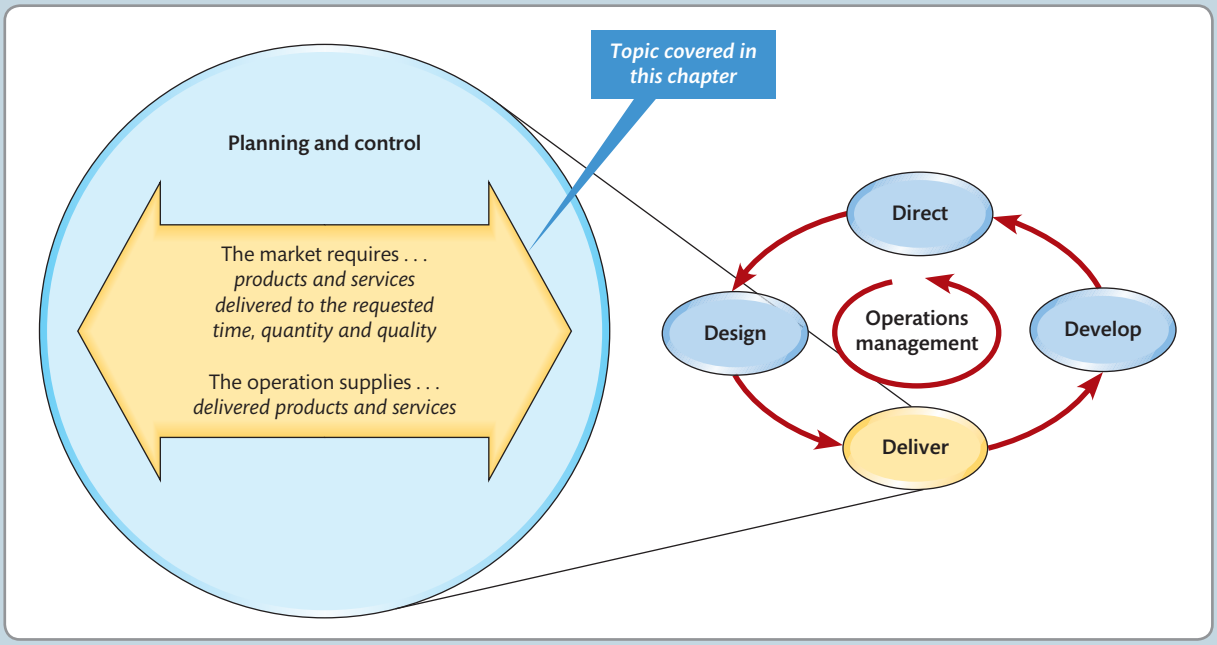

Figure 10.1 This chapter introduces planning and control

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OPERATIONS IN PRACTICE

Joanne manages the schedule[1]

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Joanne Cheung is the Senior Service Adviser at a premier BMW dealership. She and her team act as the interface between customers who want their cars serviced and repaired, and the 16 technicians who carry out the work in their state-of-the-art workshop. *'There are three types of work that we have to organize'*, says Joanne. *'The first is performing repairs on customers' vehicles. They usually want this doing as soon as possible. The second type of job is routine servicing. It is usually not urgent so customers are generally willing to negotiate a time for this. The remainder of our work involves working on the pre-owned cars which our buyer has bought-in to sell on to customers. Before any of these cars can be sold they have to undergo extensive checks. To some extent we treat these categories of work slightly differently. We have to give good service to our internal car buyers, but there is some flexibility in planning these jobs. At the other extreme, emergency repair work for customers has to be fitted into our schedule as quickly as possible. If someone is desperate to have their car repaired at very short notice, we sometimes ask them to drop their car in as early as they can and pick it up as late as possible. This gives us the maximum amount of time to fit it into the schedule.*

'There are a number of service options open to customers. We can book short jobs in for a fixed time and do it while they wait. Most commonly, we ask the customer to leave the car with us and collect it later. To help customers we have 10 loan cars which are booked out on a first-come first-served basis. Alternatively, the vehicle can be collected from the customer's home and delivered back there when it is ready. Our 4 drivers who do this are able to cope with up to 12 jobs a day.

'Most days we deal with 50 to 80 jobs, taking from half-an-hour up to a whole day. To enter a job into our process all Service Advisers have access to the computer-based scheduling system. On-screen it shows the total capacity we have day-by-day, all the jobs that are booked in, the amount of free capacity still available, the number of loan cars available, and so on. We use this to see when we have the capacity to book a customer in, and then enter all the customer's details. BMW have issued "standard times" for all the major jobs. However, you have to modify these standard times a bit to take account of circumstances. That is where the Service Adviser's experience comes in.

'We keep all the most commonly used parts in stock, but if a repair needs a part which is not in stock, we can usually get it from the BMW parts distributors within a day. Every evening our planning system prints out the jobs to be done the next day and the parts which are likely to be needed for each job. This allows the parts staff to pick out the parts for each job so that the technicians can collect them first thing the next morning without any delay.

'Every day we have to cope with the unexpected. A technician may find that extra work is needed, customers may want extra work doing, and technicians are sometimes ill, which reduces our capacity. Occasionally parts may not be available so we have to arrange with the customer for the vehicle to be rebooked for a later time. Every day up to 4 or 5 customers just don't turn up. Usually they have just forgotten to bring their car in so we have to rebook them in at a later time. We can cope with most of these uncertainties because our technicians are flexible in terms of the skills they have and also are willing to work overtime when needed. Also, it is important to manage customers' expectations. If there is a chance that the vehicle may not be ready for them, it shouldn't come as a surprise when they try and collect it.'

WHAT IS PLANNING AND CONTROL?

Planning and control is concerned with the activities that attempt to reconcile the demands of the market and the ability of the operation's resources to deliver. It provides the systems, procedures and decisions which bring different aspects of supply and demand together. Consider, for example, the way in which routine surgery is organized in a hospital. When a patient arrives and is admitted to the hospital, much of the planning for the surgery will already have happened. The operating theatre will have been reserved, and the doctors and nurses who staff the operating theatre will have been provided with all the information regarding the patient's condition. Appropriate pre-operative and post-operative care will have been organized. All this will involve staff and facilities in different parts of the hospital, all of whom must have been given the same information and their activities co-ordinated. Soon after the patient arrives, he or she will be checked to make sure that the condition is as expected (in much the same way as material is inspected on arrival in a factory). Blood, if required, will be cross-matched and reserved, and any medication will be made ready (in the same way that all the different materials are brought together in a factory). Any last-minute changes may require some degree of re-planning. For example, if the patient shows unexpected symptoms, observation may be necessary before the surgery can take place. Not only will this affect the patient's own treatment, but other patients' treatment may also have to be rescheduled (in the same way as machines will need rescheduling if a job is delayed in a factory). All these activities of scheduling, co-ordination and organization are concerned with the planning and control of the hospital.

✻ Operations principle

Planning and control involves scheduling, co-ordinating and organizing operations activities.

The difference between planning and control

Notice that we have chosen to treat 'planning and control' together. This is because the division between 'planning' and 'control' is not clear, either in theory or in practice. However, there are some general features that help to distinguish between the two. Planning is a formalization of what is intended to happen at some time in the future. But a plan does not guarantee that an event will actually happen. Rather it is a statement of intention. Although plans are based on expectations, during their implementation things do not always happen as expected. Customers change their minds about what they want and when they want it. Suppliers may not always deliver on time, process technology may fail, or staff may be absent through illness. Control is the process of coping with these types of change. It may mean that plans need to be redrawn in the short term. It may also mean that an 'intervention' will need to be made in the operation to bring it back 'on track' – for example, finding a new supplier who can deliver quickly, getting process technology up and running again, or moving staff from another part of the operation to cover for the absentees. Control activities make the adjustments which allow the operation to achieve the objectives that the plan has set, even when the assumptions on which the plan was based do not hold true.

✻ Operations principle

Planning and control are separate but closely related activities.

Long-, medium- and short-term planning and control

The nature of planning and control activities changes over time. In the very long term, operations managers make plans concerning what they intend to do, what resources they need, and what objectives they hope to achieve. The emphasis is on planning rather than control, because there is little to control as such. They will use forecasts of likely demand described in aggregated terms. For example, a hospital will make plans for '2,000 patients' without necessarily going into the details of the individual needs of those 2,000 patients. Similarly, the hospital might plan to have 100 nurses and 20 doctors but again without deciding on

the specific attributes of the staff. Operations managers will focus mainly on volume and financial targets.

Medium-term planning and control is more detailed. It looks ahead to assess the overall demand which the operation must meet in a partially disaggregated manner. By this time, for example, the hospital must distinguish between different types of demand. The number of patients coming as accident and emergency cases will need to be distinguished from those requiring routine operations. Similarly, different categories of staff will have been identified and broad staffing levels in each category set. Just as important, contingencies will have been put in place which allow for slight deviations from the plans. These contingencies will act as 'reserve' resources and make planning and control easier in the short term.

In short-term planning and control, many of the resources will have been set and it will be difficult to make large changes. However, short-term interventions are possible if things are not going to plan. By this time, demand will be assessed on a totally disaggregated basis, with all types of surgical procedures treated as individual activities. More importantly, individual patients will have been identified by name, and specific time slots booked for their treatment. In making short-term interventions and changes to the plan, operations managers will be attempting to balance the quality, speed, dependability, flexibility and costs of their operation dynamically on an *ad hoc* basis. It is unlikely that they will have the time to carry out detailed calculations of the effects of their short-term planning and control decisions on all these objectives, but a general understanding of priorities will form the background to their decision making. Figure 10.2 shows how the control aspects of planning and control increase in significance closer to the date of the event.

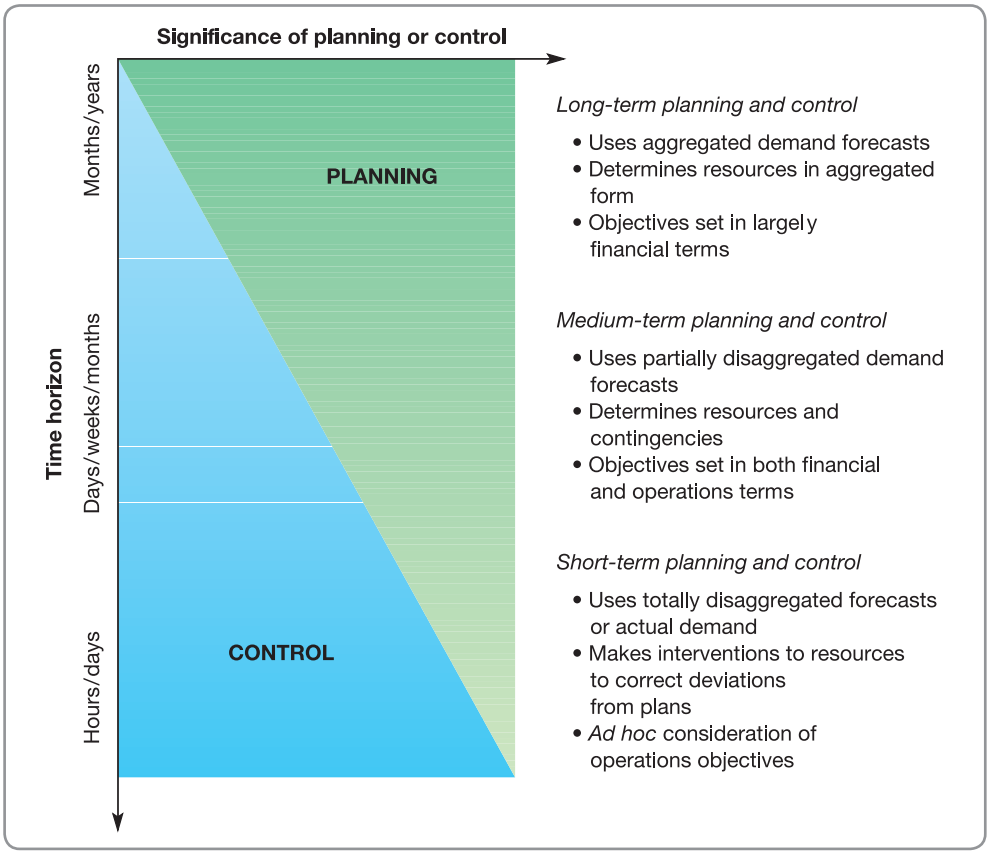


Figure 10.2 The balance between planning and control activities changes in the long, medium and short term

The volume–variety effect on planning and control

As we have found previously, the volume and variety characteristics of an operation will have an effect on its planning and control activities. Operations which produce a high variety of services or products in relatively low volume will have customers with different requirements and use different processes from operations which create standardized services or products in high volume (*see* Table 10.1).

Take two contrasting operations – an architects' practice and an electricity utility. The architects' high variety of customized services means they cannot produce designs in advance of customers requesting them. Because of this, the time it will take to finally deliver their services to customers will be relatively slow. Customers will understand this, but will expect to be consulted extensively as to their needs. The details and requirements of each job will emerge only as each individual building is designed to the client's requirements, so planning occurs on a relatively short-term basis. The individual decisions which are taken in the planning process will usually concern the timing of activities and events – for example, when a design is to be delivered, when building should start, when each individual architect will be needed to work on the design. Control decisions also will be at a relatively detailed level. A small delay in fixing one part of the design could have significant implications in many other parts of the job. For an architect, planning and control cannot be a totally routine matter; projects need managing on an individual basis. However, the robustness of the operation (that is, its vulnerability to serious disruption if one part of the operation fails) will be relatively high. There are probably plenty of other things to get on with if an architect is prevented from progressing one part of the job.

The electricity utility, on the other hand, is very different. Volume is high, production is continuous, and variety is non-existent. Customers expect instant 'delivery' whenever they plug in an appliance. The planning horizon in electricity generation can be very long. Major decisions regarding the capacity of power stations are made years in advance. Even the fluctuations in demand over a typical day can be forecast in advance. Popular television programmes can affect minute-by-minute demand and these are scheduled weeks or months ahead. The weather also affects demand, and is more uncertain, but can to some extent be predicted. Individual planning decisions made by the electricity utility are not concerned with the timing, but rather the volume of output. Control decisions will concern aggregated measures of output such as the total kilowatts of electricity generated, because the product is more or less homogeneous. However, the robustness of the operation is very low because, if a generator fails, the operation's capability of supplying electricity from that part of the operation also fails.

✻ Operations principle

The volume–variety characteristics of an operation will affect its planning and control activities.

Table 10.1 The volume–variety effects on planning and control

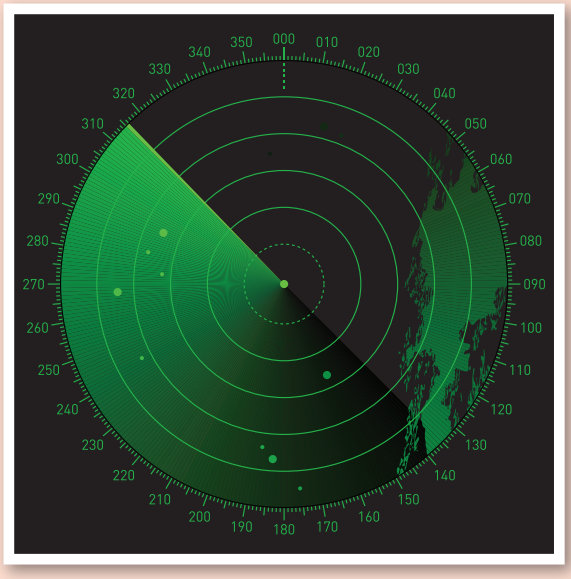
Volume	*Variety*	*Customer responsiveness*	*Planning horizon*	*Major planning decision*	*Control decisions*	*Robustness*
Low	High	Slow	Short	Timing	Detailed	High
↓	↓	↓	↓	↓	↓	↓
High	Low	Fast	Long	Volume	Aggregated	Low

SHORT CASE Operations control at Air France[2]

'In many ways a major airline can be viewed as one large planning problem which is usually approached as many independent, smaller (but still difficult) planning problems. The list of things which need planning seems endless: crews, reservation agents, luggage, flights, through trips, maintenance, gates, inventory, equipment purchases. Each planning problem has its own considerations, its own complexities, its own set of time horizons, its own objectives, but all are interrelated.'

Air France has 80 flight planners working 24-hour shifts in their flight planning office at Roissy, Charles de Gaulle. Their job is to establish the optimum flight routes, anticipate any problems such as weather changes, and minimize fuel consumption. Overall the goals of the flight planning activity are first, and most important, safety, followed by economy and passenger comfort. Increasingly powerful computer programs process the mountain of data necessary to plan the flights, but in the end many decisions still rely on human judgement. Even the most sophisticated expert systems only serve as support for the flight planners. Planning Air France's schedule is a massive job. Just some of the considerations which need to be taken into account include the following:

- *Frequency* – for each airport how many separate services should the airline provide?
- *Fleet assignment* – which type of plane should be used on each leg of a flight?
- *Banks* – at any airline hub where passengers arrive and may transfer to other flights to continue their journey, airlines like to organize flights into 'banks' of several planes which arrive close together, pause to let passengers change planes, and all depart close together. So, how many banks should there be and when should they occur?
- *Block times* – a block time is the elapsed time between a plane leaving the departure gate at an airport and arriving at its gate in the arrival airport. The longer the allowed block time the more likely a plane will keep to schedule even if it suffers minor delays. However, longer block times also mean fewer flights can be scheduled.



Source: Shutterstock.com/Alhovik

- *Planned maintenance* – any schedule must allow time for planes to have time at a maintenance base.
- *Crew planning* – pilot and cabin crew must be scheduled to allocate pilots to fly planes on which they are licensed and to keep within maximum 'on duty' times for all staff.
- *Gate plotting* – if many planes are on the ground at the same time there may be problems in loading and unloading them simultaneously.
- *Recovery* – many things can cause deviations from any plan in the airline industry. Allowances must be built in to allow for recovery.

For flights within and between Air France's 12 geographic zones, the planners construct a flight plan that will form the basis of the actual flight only a few hours later. All planning documents need to be ready for the flight crew who arrive two hours before the scheduled departure time. Being responsible for passenger safety and comfort, the captain always has the final say and, when satisfied, co-signs the flight plan together with the planning officer.

THE EFFECT OF SUPPLY AND DEMAND ON PLANNING AND CONTROL

If planning and control is the process of reconciling demand with supply, then the nature of the decisions taken to plan and control an operation will depend on both the nature of demand and the nature of supply in that operation. In this next section, we examine some differences in demand and supply which can affect the way in which operations managers plan and control their activities.

Uncertainty in supply and demand

Uncertainty is important in planning and control because it makes it more difficult. Sometimes the supply of inputs to an operation may be uncertain. Local village carnivals, for example, rarely work to plan. Events take longer than expected, some of the acts scheduled in the programme may be delayed *en route*, and some traders may not even arrive. In other operations supply is relatively predictable, and the need for control is minimal. For example, cable TV services provide programmes to a schedule into subscribers' homes. It is rare to change the programme plan. Similarly demand may be unpredictable. A fast-food outlet inside a shopping centre does not know how many people will arrive, when they will arrive and what they will order. It may be possible to predict certain patterns, such as an increase in demand over the lunch and tea-time periods, but a sudden rainstorm that drives shoppers indoors into the centre could significantly and unpredictably increase demand in the very short term. Conversely, demand may be more predictable. In a school, for example, once classes are fixed and the term or semester has started, a teacher knows how many pupils are in the class. Both supply and demand uncertainty make planning and control more difficult, but a combination of supply *and* demand uncertainty is particularly difficult.

✻ Operations principle

Planning and control systems should be able to cope with uncertainty in demand.

Dependent and independent demand

Some operations can predict demand with relative certainty because demand for their services or products is dependent upon some other factor which is known. This is known as dependent demand. For example, the demand for tyres in an automobile factory is not a totally random variable. The process of demand forecasting is relatively straightforward. It will consist of examining the manufacturing schedules in the car plant and deriving the demand for tyres from these. If 600 cars are to be manufactured on a particular day, then it is simple to calculate that 3,000 tyres will be demanded by the car plant (each car has 5 tyres) – demand is dependent on a known factor, i.e. the number of cars to be manufactured. Because of this, the tyres can be ordered from the tyre manufacturer to a delivery schedule which is closely related to the demand for tyres from the plant (as in Fig. 10.3). In fact, the demand for every part of the car plant will be derived from the assembly schedule for the finished cars. Other operations will act in a dependent demand manner because of the nature of the service or product which they provide. For example, a custom-made dressmaker will not buy fabric and make up dresses in many different sizes just in case someone comes along and wants to buy one. Nor will a high-class restaurant begin to cook food just in case a customer arrives and requests it. In both these cases, a combination of risk and the perishability of the product or service prevents the operation from starting to create the goods or services until it has a firm order. Planning and control in dependent demand situations is largely concerned with how the operation should respond when demand has occurred.

By contrast, some operations are subject to independent demand. They need to supply future demand without knowing exactly what that demand will be; or in the terminology of planning and control, they do not have firm 'forward visibility' of customer orders. For example, the Ace Tyre Company, which operates a drive-in tyre replacement service, will need to manage a stock of tyres. In that sense it is exactly the same task that faced the manager of tyre stocks in the car plant. However, demand is very different for Ace Tyres. It cannot predict either the volume or the specific needs of customers. It must make decisions on how many and what type of tyres to stock, based on demand forecasts and in light of the risks it is prepared to run of being out of stock. This is the nature of independent demand planning and control. It makes 'best guesses' concerning future demand, attempts to put the resources in place which can satisfy this demand, and attempts to respond quickly if actual demand does not match the forecast. Inventory planning and control (treated in Chapter 12) is typical of independent demand planning and control.

✻ Operations principle

Planning and control systems should distinguish between dependent and independent demand.

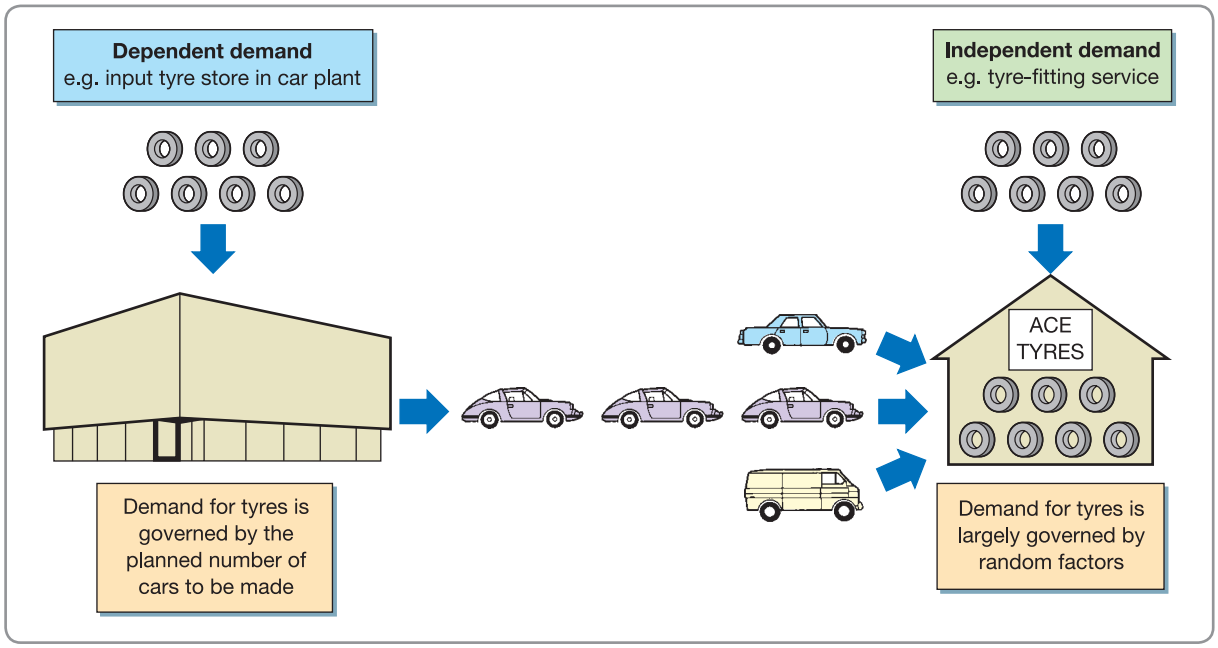


Figure 10.3 **Dependent demand is derived from the demand for something else; independent demand is more random**

Responding to demand

It is clear then that the nature of planning and control in any operation will depend how it responds to demand, which is in turn related to the type of services or products it produces. For example, an advertising agency will only start the process of planning and controlling the creation of an advertising campaign when the customer (or client, as the agency will refer to them) confirms the contract with the agency. The creative 'design' of the advertisements will be based on a 'brief' from the client. Only after the design is approved are the appropriate resources (director, scriptwriters, actors, production company. etc.) contracted. The actual shooting of the advertisement and post-production (editing, putting in the special effects, etc.) then goes ahead, after which the finished advertisements are 'delivered' through television slots. This is shown in Figure 10.4 as a 'Design, resource, create and deliver to order' operation.

Other operations might be sufficiently confident of the nature of demand, if not its exact details, to keep 'in stock' most of the resources it requires to satisfy its customers. Certainly it will keep its transforming resources, if not its transformed resources. However, it would still make the actual service or product only when it receives a firm customer order. For example, a website designer will have most of its resources (graphic designers, software developers, specialist development software, etc.) in place, but must still design, create and deliver the website after it understands its customer's requirements. (See the short case on Torchbox in Chapter 1.) This is shown in Figure 10.4 as a 'Design, create and deliver to order' operation.

Some operations offer relatively standard services or products, but do not create them until the customer has chosen which particular service or product to have. So a house builder who has standard designs might choose to build each house only when a customer places a firm order. Because the design of the house is relatively standard, suppliers of materials will have been identified, even if the building operation does not keep the items in stock itself. This is shown in Figure 10.4 as a 'Create and deliver to order' operation. In manufacturing it would be called a 'Make to order' operation.

Some operations have services or products that are so predictable that they can start to 'create' them before specific customer orders arrive. Possibly the best-known example of this is Dell Computers where customers can 'specify' their computer by selecting between

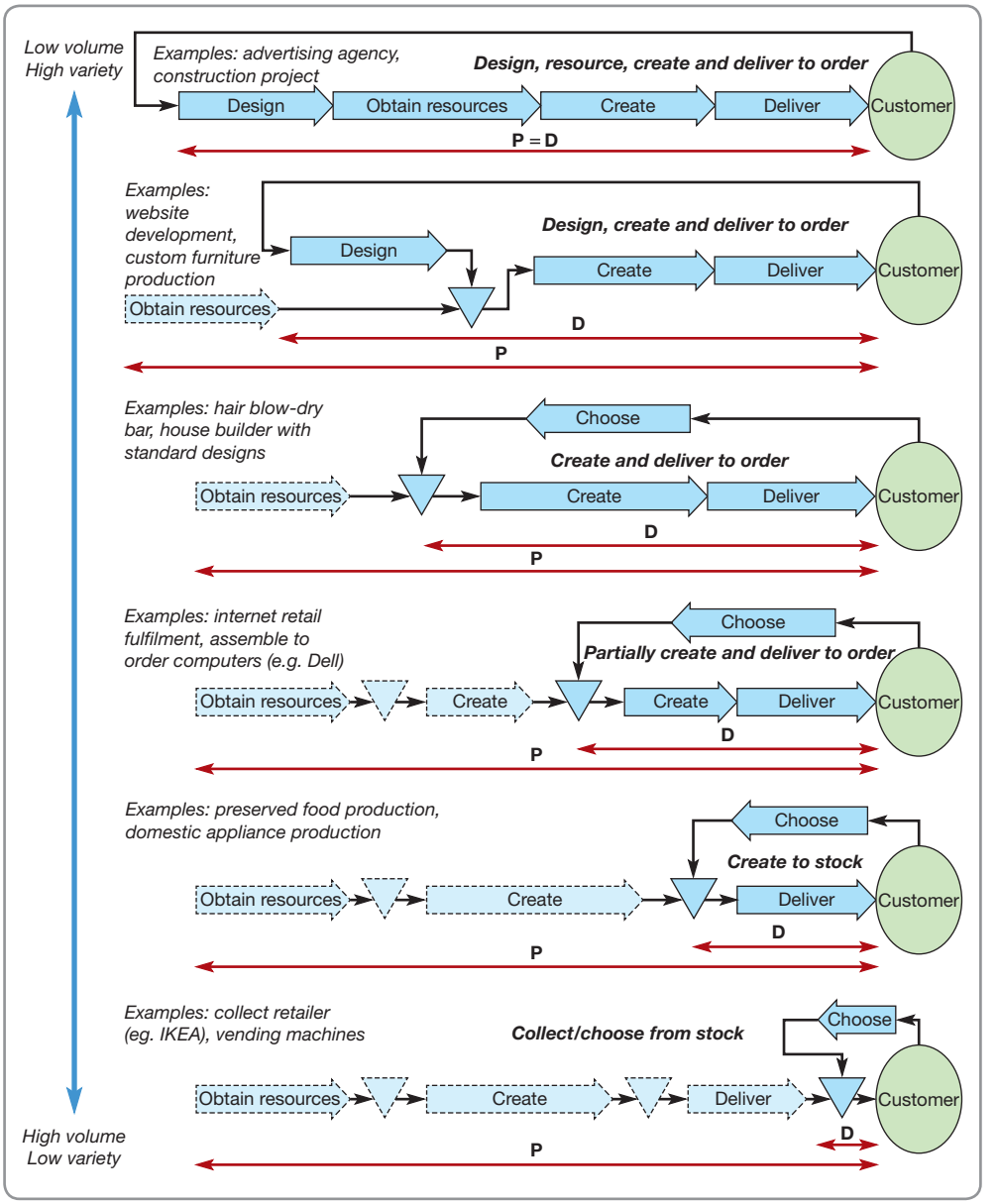


Figure 10.4 The *P:D* ratio of an operation indicates how long the customer has to wait for the service or product as compared with the total time to carry out all the activities to make the service or product available to the customer

various components through the company's website. These components will have already been created (usually by suppliers) but assembled to a specific customer order. This is shown in Figure 10.4 as a 'Partially create and deliver to order' operation. In manufacturing it would be called an 'Assemble to order' operation.

When an operation's services or products are standardized, there is the potential to create them entirely before demand is known. Almost all domestic products, for example, are 'Create to stock' or 'Make to stock' (shown in Figure 10.4) from which they are delivered to customers. Taking this evolving logic to its conclusion, some operations require their customers to collect their own services or products. This is the 'Choose/collect from stock' illustration in Figure 10.4. IKEA and most high-street retail operations are like this.

✻ Operations principle

The planning and control activity will vary depending on how much work is done before demand is known.

SHORT CASE Taxi app replaces dispatching office[3]

Source: Shutterstock.com/Kencko

The key input to any planning and control system is information. Information on what customers have ordered, or are likely to order, information on what resources are available to meet customer orders, information on priorities, and so on. This is no truer than when you order a taxi. The job of managing the constant flow of customer requests and matching them to taxi availability has traditionally been the responsibility of central 'dispatching centres'. They are an information clearing-house, offering customers a central point of contact and offering busy drivers directions to the nearest prospective passenger. Taxi drivers pay these dispatchers a fee to keep the jobs coming. But then the central dispatching operations started to be threatened by location-enabled smartphones. These offered the potential directly to connect customers with drivers, effectively cutting out the middleman. One of the most popular apps of this type is the myTaxi app. It started when the two founders of Intelligent Apps GmbH visited a strange town and were faced with a number of questions. What is the number for the nearest taxi office? Why is there still no single taxi ordering service covering multiple towns and cities? Can't things be easier? Why isn't there an app for ordering a taxi? Why isn't there a way of bringing the conventional outdated taxi ordering system into the twenty-first century?

Their myTaxi operation offers a passenger and driver app. It allows customers unobtrusively to order a cab before their meeting has finished; call a taxi from inside a noisy club; or arrange a lift during the closing credits at the cinema. *'It saves time, it's comfortable and it works'*, says myTaxi, *'even if you know neither where you are nor the number of the local taxi office. With just one click, you can send your request to all available taxi drivers in the immediate vicinity. You can even request special features without uttering a word, such as a child seat, debit card payment or a large taxi for when you're travelling with mountains of luggage. Both driver and customer know the route and the location, meaning you can track the taxi's arrival live on the map.'* The taxi drivers also like their new freedom. *'The transparency of this new ordering system initially gives rise to an intimate atmosphere between drivers and passengers. I like the myTaxi system for its efficiency. I have many regular customers within my city – the app helps me in optimizing working hours between regular tours'*, said Michael Dworak, a Berlin taxi driver.

One point to note in the operations illustrated in Figure 10.4 is that there is a relationship between how operations respond to demand and their volume–variety characteristics. It is easy to see that 'Design, resource, create and deliver to order' operations are intended for low-volume and high-variety businesses. By definition, designing different services or products will result in high variety, and performing each activity for each customer would be too cumbersome for a high-volume business. Conversely, 'Create to stock' and 'Choose/collect from stock' clearly rely on standardized services or products.

P:D ratios[4]

Another way of characterizing the graduation between 'Design, resource, create and deliver to order' and 'Choose/collect from stock' planning and control is by using a *P:D* ratio. This contrasts the total length of time customers have to wait between asking for the service or