

# Operations Management

## 1.1 Introduction

Teaching the material in Chapter 1 of the book is both the most important and the most difficult part of teaching an operations management course. Most important because it is vital that students develop an enthusiasm for the subject and this is best attempted early in the course. Difficult because one has to establish some key principles before the 'building blocks' of the subject have been taught. We have found it useful always to work from whatever experience the students have. For post-experience students like MBAs this is not difficult. One can always ask them to describe the nature of operations in the companies they have worked for. One can even explore some of the prejudices they might hold about operations management (dull, obstructive, always screwing things up, etc.) and base discussions on that. Undergraduates are more difficult because they usually have less experience, but even so they have experienced many different operations from a customer's point of view. Therefore one can ask them about recent experiences as a customer (both good and bad) and base a discussion on the importance of operations management around those experiences.

### ***Key teaching objectives***

- To enthuse students with the 'hands-on' excitement that can be gained from an understanding of operations management ("*... I want to prevent you ever enjoying a theatre performance, restaurant meal, or shopping experience ever again. I want you continually to be looking for the operations implications of every operation you enter. You are going to be turned into sad people who cannot go anywhere without thinking of how you could improve the process*").
- Convince students that **all** organisations really do have an operations function, therefore operations management is relevant to every organisation.
- Convince students that **all** managers are operations managers because all managers manage processes to produce outputs. ("*Even marketing managers are operations managers. What you learn as marketing in business school is really the 'technical' side of marketing. Of course this is important, but marketing managers also have to produce marketing reports and information, without mistakes in them, on time, relatively quickly,*

*flexibly enough to contain the latest information, and without using an army of marketing analysts to do so. In other words, they are producing services for internal customers”).*

- To introduce the some key ideas in the chapter, namely,
  - Operations managers manage transformation processes, with inputs and outputs.
  - Operations can be analyzed at three levels; the level of the supply network; the level of the operation itself (sometimes called the level of the organisation), and; the level of individual processes.
  - Operations differ in terms of their volume, variety, variation and visibility (the four Vs).
  - Operations managers engage in a set of activities, devising operations strategy, designing operations, planning and controlling operations, improving operations.

## 1.2 Exercises/discussion points

There are many cases and exercises which one could use to introduce operations management. You might like to try some of these ideas, all of which we have used.

- **Teaching tip** - Use the pie-chart that shows the consultancy spend in each functional area (a PowerPoint version is available with the other PowerPoint slides) to prompt a discussion. For example, *“Operations and process management is the biggest single sector of spend in the consultancy market. Why do you think this is?”* Try to guide the discussion to the idea that excellence in operations management both reduces the cost base of the operation **and** helps to bring in more revenue. We call this the ‘double whammy’ effect of operations. No wonder it is important when it can do both these things. *“Remember the old adage; profit is a very small number, made up of the difference between two very big numbers. It only takes a bit to be taken off costs and bit to be added on to revenue to make a big difference to profit.”*
- **Exercise** - A useful exercise for demonstrating the ubiquitous nature of operations is to ask the class to identify every service they have encountered from waking up in the morning through to going to bed at night. The radio alarm which wakes them up depends on the operations of the radio station. The water in which they wash (presumably) was delivered by a water utility. The public transport operation transported them to college, etc. etc., through to the bar, or other place of entertainment that they finish the day with.
- **Teaching tip** - Many television programmes can be recorded off-air which illustrate operations. Looking ‘behind the scenes’ of well-known operations such as airports, is a favourite topic for TV producers. Any of these could be used to promote group discussions

on what operations management might be like in such operations. U-tube is also a valuable resource.

- **Exercise** - The four Vs dimensions of operations can be used for many types of exercise. For example, one could ask different groups to identify different types of restaurant, food retailer, car servicing operation, cinema, club or pub, etc. and plot the 'similar but different' operations on the four dimensions.
- **Exercise** - For residential courses, especially of post-experience students, an evening could be spent 'on the town', where syndicates are required to sample the services of a restaurant, a retail operation, and an entertainment operation, and report back the following morning. This is a great way of giving participants a change of scene on the Thursday of a one-week course.
- **Teaching tip** - Remember 'role-play' can be used effectively in an introductory session. The lecturer can role play two operations managers managing separate similar but different operations. For example, the chief tailor of a 'fashion label' custom tailor and the production manager at a mass-produced 'off-the-peg' garment factory manager. The differences in the types of resource (people and equipment), the operation's objectives, the four Vs, etc. can all be emphasised during the role play.
- **Teaching tip** - 'Role-play' can also be used with a standard case study. For example, the Concept Design Services case at the end of Chapter 1 lends itself to role playing the operations manager and marketing director of the company, in order to illustrate their different perspectives.
- **Exercise** - All the chapters start with an 'Operations in practice' example. It is often a good idea to ask the students to read through this example and then use it to promote a discussion on the topic. In this chapter IKEA is described. Questions such as the following could be used to prompt discussion.
  1. Did either of this company simply conform to the conventional operations model in their sectors or did they devise something new?
  2. What did this company do differently from previous furniture retailers?
  3. Why do you think they decided to be different from other companies in their sector in the way they manage their operations?
  4. What advantages did making these changes give them?

See later for suggested answers to these questions.

- **Teaching tip** - It is always worth illustrating the ideas in operations and process management with reference to not-for-profit organizations. Charities, local government

organizations, and particularly health care services (although some of these are private) provide a wealth of examples. For example, try asking the students to contrast an accident and emergency (A&E) department of a hospital with a unit that specialises in cosmetic surgery. The former has to cope with very high variety, high variation, and high visibility. Demand is relatively unpredictable and it must provide fast and responsive service (relatively at least, it would be measured in minutes and hours rather than weeks and months). The cosmetic surgery unit by contrast, may still have high variety but, because patients are more able to wait, it is unlikely to have very high variation. Because of this, the process can be planned and scheduled in advance so there will be far higher utilization of the process's resources.

### 1.3 Suggested questions and answers to 'operations in practice' and short cases

#### IKEA

Suggested questions.....

1. *How is the IKEA operations design different from that of most furniture retail operations?*
2. *What do you think might be the major problems in running an operation like IKEA?*
3. *What do you identify as the 'operations function' within IKEA? How is this different from the 'sales function'?*

#### ***How is the IKEA operations design different from that of most furniture retail operations?***

Although some furniture retailers do have large 'out of town' operations many use premises within town or shopping malls. IKEA's operations are very large and purpose built. They feature very large car parks and are located close to major motorway intersections. In fact everything about the design of IKEA's operations encourages high volume of throughput. This high volume means that many of the fixed costs of running the IKEA operation such as local taxes, administrative costs, and some energy costs are spread over a high volume of individual sales transactions. This reduces the overall cost of making a sale, part of IKEA's strategy of offering good value for money. The variety of **products** sold in IKEA store is relatively large compared with many furniture retail operations. For example it includes small items such as glassware and kitchenware as well as very large items such as sofas, tables and shelving systems. Modular design of some products such as shelving systems allows variety to be extended even further from a few basic component parts. These components can be assembled together (by the customers) in different ways to offer an almost infinite variety of combinations. However as far as the variety of **service** is concerned, it is relatively narrow. Most products are sold in cartons, customers are left to make decisions by themselves without interference from sales staff

(though advice is available if requested), and even when ordering special products the order is taken down by staff in a standardised form. The check-out operation, where customers pay for the goods, is also highly standardised with everyone going through exactly the same sequence of activities. Even delivery to the customer's home is largely a matter of the customer carrying the goods themselves in their own cars (though a delivery service is also available). As far as demand variation is concerned, weekends and public holidays are much busier than working week days, therefore variation is relatively high. However, from IKEA's experience, demand is relatively predictable. Because of this predictability they can plan to have more staff available at busy periods. However, also because customers are encouraged to perform much of the service themselves, the need to fluctuate staff is less than it would be in a conventional store. Also in conventional stores, because of the high level of expertise and customer contact required, it is much more difficult to obtain the services of part-time staff during peak demands. The relatively standardised and simplified service given by IKEA makes it easier to schedule part-time staff in busy periods. Finally, customer contact is, in some parts of the operation, high, but overall it is lower than most furniture retail operations. Consider, customers are responsible for choosing which types of furniture they require, working out whether this furniture would fit together in their own home (special sheets and tape measures are provided by IKEA to help customers do this), filling in order forms when special furniture has to be delivered, serving themselves to smaller items into trolleys, entering the warehouse area and picking out from the warehouse shelves the cartoned larger items, transporting the goods through to the checkout, and finally loading the goods on to their own car. Most of this occurs with very little customer contact. In many instances the only point at which interaction takes place between customer and service staff is at the point of payment. In effect the customer is 'trained' to perform much of the value adding part of the service themselves. Clearly this cuts down the costs of the transaction as far as IKEA is concerned. These savings can then be passed on to the customer.

#### **What do you think might be the major problems in running an operation like IKEA?**

The dependency on a high degree of customer participation has some advantages but it also may have some drawbacks. Customers need to be 'trained' by clear use of signing, by instructions within the brochures and catalogues, and by observing other customers behaviour. Furthermore, the store needs to be laid out such that it is difficult for customers to deviate from the standard route through the store to the checkout. However some customers may not behave in the prescribed manner and staff will need to be able to cope with these exceptions. If this customers training is not well handled several difficulties can arise. For example, customers may pick up goods from shelves or the warehouse, change their mind and then leave them around the store in unsafe positions. Alternatively if customers are puzzled by the nature of the operation they will need tactful help from customer contact staff. The other major problem facing

the store would probably be stock availability. The system works best when all items requested by customers are in fact in stock. Out-of-stock items not only disappoint the customer but cause extra cost in terms of administration and ordering. This is an especial problem in modular based products such as shelving systems. If one particular module is not available it could impact on a large proportion of the customers who want to purchase some combination of modules.

**What do you identify as the 'operations function' within IKEA? How is this different from the 'sales function'?**

The overall macro operation at IKEA is concerned with serving customers with their required furniture products. In this sense it is a customer processing operation. However to achieve this there are in effect two parallel sets of micro operations. The first one deals with the flow of customers such as the show room, the child-minding facility, the checkout operation and so on. The second set of operations are concerned with material flow. These are things such as the goods inwards receiving operation, the warehouse operation, and the shelf stocking operation for the smaller items. In effect these two sets of micro operations are arranged so that products are 'assembled' to the customers (or look at another way, the customers assemble themselves to the products!). It becomes clear that practically everybody within the store is concerned in some way with one of these two sets of micro operations, either transforming customers or transforming material. This means that the operation of 'making the sale' and therefore 'satisfying customers', although sales activities, are in fact the heart of the operation itself. In contrast the marketing operation is concerned with the technical decisions of pricing, promotion and product selection etc. These decisions are probably taken at a regional headquarters (which are information processing operations in effect).

## **Acme Whistles**

Suggested question

1. What is the overlap between operations, marketing and product/service development at Acme Whistles?

**What is the overlap between operations, marketing and product/service development at Acme Whistles?**

The simple answer to this question is, "There is a very significant overlap between these functions". The underlying question is 'Why?' Partly the reason is size. As Simon Topman says in the example, small companies cannot afford specialist functions so at a managerial level everyone does everything to some extent. This becomes especially true when the boss of the

company is also the owner. It is literally his own money that is being spent when creating any new managerial roles. Partly also the tradition and competitive stance of the company has an influence. This is a company that competes on quality and innovation. Both these things rely on informal communications within the organisation and a fast moving, agile ability to check out and implement new ideas.

## **Oxfam**

Suggested question

1. What are the main issues facing Oxfam's operations managers?

### **What are the main issues facing Oxfam's operations managers?**

Broadly, Oxfam will have the same issues as any other operation. They must define their strategic objectives, design appropriate processes that deliver appropriate services, plan and control those processes, and continually adapt and improve how they deliver their services. But they also have some particularly difficult challenges because of their status as an emergency and caring organisation.

- The must provide a global service. - By definition, Oxfam's scope of operations is global. Anywhere a disaster is likely to strike could receive the attentions of the charity. However, much of Oxfam's work is not concerned with the high profile disaster relief side of its business, but rather the ongoing community development projects it undertakes. Most of these projects will be in the poorer, less developed parts of the world. The implication of this is that, from an operations point of view, services must be delivered without an assumed level of infrastructural support. The ability to adapt development methodologies to such circumstances would be a key operations task. Another aspect of globalization for Oxfam concerns the coordination of expertise. Experts, either in development or disaster relief, may be located anywhere in the world. The task of understanding and coordinating this pool of potential help must be a major operations task. It will rely on maintaining a database of expertise and on the ability to deploy it, sometimes at short notice.
- They must be environmentally ethical. - To Oxfam, the concept of environmental management must be tackled at two levels. The most obvious one is that environmental awareness is an 'output' from the charity's operations. In other words, environmental management, to some extent, is one of the operation's 'products'. It will engage in lobbying governments and non-governmental agencies to achieve its aims of greater environmental sustainability. However, there is also another, related, issue. Oxfam's operations themselves must also be environmentally sound. Agricultural projects for

example, must be managed to ensure that there is not inappropriate use of fertilisers and pesticides locally, even when there may be local pressures to do so.

- They must be socially responsible. - Again, this is one of those issues which is both an output from the operation and an objective for the way it runs its own operations. A key issue here must be the way in which the 'on the ground' managers of development projects tackle some of the particularly sensitive cultural issues. For example, 'gender issues' are one of Oxfam's campaigning points; however, appropriate gender roles are seen in very different ways in different parts of the world. Pursuing its own ends in terms of, say girls' education, must be balanced against traditional ideas of women's role. Whereas this difficulty may be relatively straightforward to reconcile at a strategic level back in the charity's Oxford headquarters, its success depends on how local operations managers deal with the issue at a day-to-day level.

## **Prêt A Manger**

Suggested questions

- 1. What are the advantages and disadvantages of Prêt A Manger organizing itself so that the individual shops make the sandwiches that they sell?*
- 2. How can effective operations management at Prêt A Manger contribute significantly to its success? And what would the consequences of poor operations management be in this kind of organization?*

**What are the advantages and disadvantages of Prêt A Manger organizing itself so that the individual shops make the sandwiches that they sell?**

There are a number of advantages in this type of organization.

- The load on the staff in the shop is equalized throughout the day. The demand from customers for purchasing the sandwiches occurs mainly in the middle of the day. If the staff only sold sandwiches, they would be busy in the middle part of the day and unoccupied at other times. The way Prêt a Manger organize their processes, the staff can occupy themselves making sandwiches in the early part of the day, then, as the day progresses, staff will progressively move from making to selling. As demand then reduces towards the end of the day, staff will move onto general cleaning and tidying activities as well as making ready for the same cycle of activities to repeat itself the next day.
- There is clear and direct responsibility for quality, customer service, and cost. If there are any problems with quality and availability of sandwiches, it is the same staff that caused the problems who receive customer complaints. (In fact, Prêt a Manger get very complaints). Similarly, the effectiveness of cost control can be clearly associated with the staff in the shop.



- It is a more interesting job that has a number of different activities (making, selling, cleaning, etc.) than one where an individual will specialize in just one of these tasks.
- It is easier to engender a sense of pride in the high quality and wholesome nature of the products when they are made on the premises.
- It should be pointed out that there also disadvantages. The main one is that the cost of making sandwiches in a sandwich factory (the way the vast majority of sandwiches are made) is very significantly cheaper because of the higher volume.

**How can effective operations management at Prêt A Manger contribute significantly to its success? And what would the consequences of poor operations management be in this kind of organization?**

- By developing a culture within each store that takes pride in the products themselves, the way they are made, and the way customers are served.
- By listening to customers so that customers' reactions and comments can inform the design of new products.
- By not wasting materials through poor control which would increase the cost of running the operation.
- By developing a sense of fun as well as a sense of commitment in staff so that customers sense a friendly and relaxed atmosphere.

## **Two very different hotels**

Suggested questions

1. For each hotel, what is the role of technology and the role of the operation's staff in delivering an appropriate level of service?
2. What are the main differences in the operations management challenges facing the two hotels?

**For each hotel, what is the role of technology and the role of the operation's staff in delivering an appropriate level of service?**

For Formula 1, technology is harnessed in the manufacture of the self-contained bedroom units in the factory prior to assembly on the site. Because of the standardisation, conventional factory automation can be used to some extent. More obviously, during the running of normal

operations at the hotel, technology, in the form of the automatic 'booking in' machine at the door, allows the hotel to remain 'open' even while it is unstaffed for much of the day. This saves labour. Similarly, labour is saved by the use of automatic cleaning in the washrooms. This also ensures that high standards of cleanliness are maintained throughout the day, even when the hotel is not staffed. Although not mentioned in the text, Formula 1 hotels also have automatic drinks and snack dispensers which allow guests to stave off hunger and thirst even though the hotel does not provide food in a conventional restaurant setting.

At the Mwagusi Safari Lodge, very little technology is used. The attraction of the hotel lies in its location and in how their staff treats the guests. Staff must not only be informative and courteous, they will also need to protect and reassure those guests who are anxious in their surroundings and create a sense of adventure (but not too much adventure).

### **What are the main differences in the operations management challenges facing the two hotels?**

The main difference is the degree of standardization in the operation's processes. For Formule 1, the main use of standardisation is in the manufacture of the individual room units. All room units are exactly the same size. Because they all have the same fitting, these fittings can be partly installed at the factory. This allows the company to buy furniture, curtains, carpets etc. in high volume keeping costs down. The standardised nature of the units also allows the hotel to be constructed quickly (which itself saves costs) using standardised methods of construction which are cheaper than building entirely different hotels at each site. Standardisation of rooms also allows a standardised procedure to be adopted for cleaning and maintenance, so staff can be easily trained using a standardised training package. Finally, standardisation of the room units, paradoxically, allows all Formule 1 hotels to adapt to the geography of the site. By putting the standard units together, like children's building blocks, they can use unusually shaped pieces of land which tend to be cheaper than regularly shaped sites. By contrast, the Mwagusi Safari Lodge provides experiences 'customized for every visitor's requirements and abilities'. Also the Mwagusi Safari Lodge must be able to cope with fluctuations in demand through the year. However, Formule 1 try to choose locations that capture the business traveller market during the week and leisure travellers at the weekend.

## **1.4 Further examples**

### **ANLG Bank**

by Alan Betts

*"We've grown and reorganized so much in the last five years that it has become difficult to maintain a common approach to our operations. We have to get it right, never before have we been so dependent on how we manage our service delivery in all parts of the bank. Large retail banks like us are under immense pressure from the niche companies. They will take just one part of our range of services, such as loans or insurance or home mortgages, and really concentrate their operation on providing specifically what that market wants. They can be focused and single minded on just one part of the financial services market. Compared with them we can seem slow and unresponsive. Our advantages are the recognition our brand gets in the market, our ability to 'cross-sell' (that is, use the contact with customers in one service, for example a simple current account, to sell other services, for example a credit card), and our potential to achieve economies of scale. The challenge for us is to do two things at the same time. First, we need to deliver exceptional customer service. Big banks do not have the best reputation for their quality of service, so the first to really develop a genuine reputation for quality could reap substantial benefits. Second, we need to exploit our size to keep costs down. We are several times larger than most of the specialist financial service providers, we should be able to do things substantially cheaper than them."* (Jan Krechner, Operations Director, ANLG Bank).

The problems faced by ANLG were not unusual in the banking industry. ANLG operated largely in the Netherlands, but big retail banks all over Europe faced the same issues. They had to attempt to get the 'best of both worlds' of improving customer service while reducing the costs of providing that service. Jan knew that the only way to do this was through improving the performance of all the operations processes which produced and delivered the bank's services. Most banks, including ANLG, had moved progressively towards organizing themselves around a network of large processing centres. This was very different to how banks were organized only a few years earlier. Then each branch of a bank was far more self-contained. Managers had considerable discretion and each branch had its own back-office operation. This would record customer requests, process all financial transactions such as cheques and standing orders, issue cheque books, purchase stocks and shares for their customers and so on. Only a limited number of activities such as cheque clearing, or the physical movement cash, was organized centrally by the bank's headquarters.

Now branches are mainly sales operations. They have managers but generally have far less individual discretion. Back-office operations are now entirely centralized. Account management centres open accounts and set up standing orders, printing departments manufacture cheque books, voucher processing centres process cheques and other documents, call centres deal

with various services such as loans or credit card queries, and so on. ANLG, like most banks, had saved considerable sums from reorganizing in this way. But Jan knew that more needed to be done. "I am sure that we have barely scratched the surface in terms of exploiting the cost savings which are possible from the reorganizations, but just as important we have to overcome some of the quality issues which have arisen because of the communication problems between the back-office centres".

To help him do this Jan had organized an 'operations development programme' (ODP). Initially this was a working group which had been asked to develop some core principles for improving operations performance. One of the first problems the working party faced was that different parts of the bank regarded themselves as being different from all the other parts.

To stimulate thought and debate Jan asked managers of four of the different back office centres to attend a working group meeting and present their thoughts on "My biggest issue"

The four people chosen were a Call Centre manager dealing with customer service enquiries, a manager in charge of Credit control for personal customers, a manager running a Voucher Processing centre and a manager who works in a subsidiary company dealing with 'high net worth' (rich) clients.

### **Call Centre**

"My biggest issue is the Inbound Calls Screen. That tells me the amount of calls being handled by the operators and the amounts queuing. Monday morning just after 9a.m. the screen is going crazy, that's when we are at our busiest. Sometimes during the night shift it's a real surprise when the phone rings. The next biggest issue is staff turnover as it takes usually 4 weeks to recruit and a similar time to train someone as we look to handle 15 basic banking enquiries from our customers and people need a fair amount of background knowledge."

### **Credit control**

"Very occasionally we will speak to a customer but really we are a back office operation. We monitor the "Out of Control" accounts. Every day we get a list of customers who have exceeded their overdraft levels and it is our job to decide whether to bounce the cheque or send a letter. The number of lines on the printout varies a little bit but not really that much. I look after the personal team who basically work to strict rules whilst corporate credit control is monitored by a different team as there is a need for more interpretation."

### **Voucher Processing**

"It's really about keeping the cheque encoding machines rolling. Cheques come to us by courier from branches in a wide geographical area and we process them through 4 large and extremely expensive machines. They start arriving around lunchtime and carry on until around

7p.m. Monday is our busiest day as shopkeepers deposit their weekend takings. Sometimes running up to Christmas it can be manic and we really struggle to get the work on before cut-off time. If a machine breaks down on the Monday before Christmas we are in real difficulties.”

### **High Net worth Banking**

“I guess flexibility is the key word. Our customers are extremely wealthy and extremely demanding. We never know what the next phone call will bring but we have to be able to deal with it because if we can’t we know someone else will. Sometimes it is a small query but the customer will ask for their regular point of contact, sometimes it is a really big issue and one of our account executives will have to get over to the customers workplace – or often their home – straightaway. It is the personal touch that really matters”

Jan thanked the managers for their presentations and summarised:

*“I am coming to see that the issue of ‘similarities versus differences’ as being the key to our future improvement. On one hand, we must have a common set of principles which all the business can use to continuously improve its operations performance. On the other hand, we have to recognize that not all parts of the business are the same. And because they are different they will need to develop different skills and possibly even different approaches to ‘fine tuning’ their operations improvement activities”.*

### **Questions**

- 1 What are the inputs, transformation processes and outputs from the processes described in the case?
- 2 Determine the similarities and differences between the four back office units using the ‘4Vs’ approach.
- 3 In the light of your findings, to what extent do you believe common sets of principles apply?
- 4 What do you think are the different skills and different approaches to ‘fine tuning’ the improvement activities that Jan speaks about?

## **ANLG Bank Teaching Note**

### **Using the Case Exercise**

This exercise is best used as an introductory exercise towards the beginning of any operations management course. It is a ‘soft’ exercise in that much of the data are in the form of opinion.

The ANLG Bank case highlights the range of different operations within one organisation and can be used early in the course.

Primarily ANLG Bank demonstrates the differences and similarities of different operations through the use of the “4Vs” typology. The overview “commentary” by the Operations Director aims to show how these differences need to be understood and strategies and plans adapted rather than adopting a “one size fits all solution”

The case can also be used to stimulate a debate on the range of micro operations within an industry such as Financial Services.

At the end of the case exercise students should be able to understand the 4Vs typology and be able to apply it in different circumstances. This in turn should facilitate a better understanding of the need to manage different types of operations in differing ways later in the course

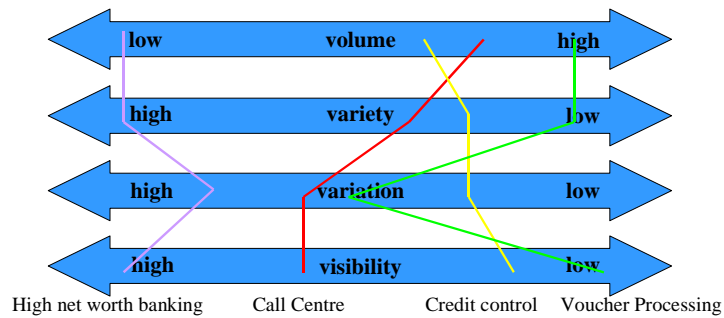
### **1. Using the “4Vs” approach helps to crystallise the differences and similarities**

The Call Centre is essentially a mid to high volume operation. This is not necessarily true of all call centres and is largely determined by the call length. There is some variety, the human interaction determines this in part as does the fact that 15 basic enquiries are handled.

Variation is certainly present in terms of variation within the day, between different days of the week and seasonal. Having said that the variation is to a large part predictable. Visibility is in the mid range; on one hand the operators are dealing directly with the public but on the other they are following laid down procedures and scripts.

Credit Control is a lower volume business than the call centre and has relatively low variety (this would not be the case in the corporate credit control function). Variation is largely predictable and easier to manage as there is a known lag between increased customer spending and appearance on the "out of control" list. Direct customer contact is unusual.

Voucher Processing is a classic high volume, low variety operation. Variation does occur but it can be predicted with a degree of accuracy. Visibility is very low.



High Net Worth Banking is at the other end of the scale. The volume is low with each customer having a named point of contact for any query. The queries vary enormously from one customer to the next and the staff need a broad range of knowledge and life skills to deal effectively. Variation in demand is high although there is some predictability in terms of activity before the end of the tax year. Visibility is very high.

2. One of the strengths that the large bank has against its smaller competitors is around the issue of “brand”. This can be a double edged sword however as mistakes and subsequent bad press in one part of the bank can quickly “stick” to other parts of the organisation. So no matter where you are in the organisation issues about “quality” and “customer service” are vital.

In the case of the various back office functions each has a role to play in supporting corporate strategy and in addition the interactions between the functions mean that working together is vital to maintain these aspects of “quality” and “customer service”

For example a high net worth customer’s cheques will be processed by the Voucher Processing Centre and any difficulties will need to be swiftly resolved. Likewise, a customer’s first point of query may well be the Call Centre and the customer’s perception of the bank’s service will be affected by the manner with which the call centre and other departments work together.

Guiding principles around understanding the demands of issues of other departments, communication and of working together to ensure “quality” and “customer service” need to be developed.

3. So whilst there needs to be common sets of principles to ensure the different units communicate and work together to ensure quality and customer service the 4Vs analysis dictates that different approaches are needed.

4.

For example different strategies for exploiting cost savings will need to be considered. The flexible requirements of the High Net Banking will result in lower productivity than, say, the Voucher Processing Centre.

Different skills will be needed by the managers of the different units. A Manager in charge of the Voucher Processing centre will be primarily concerned with keeping the big machines fully utilised whilst the manager of the High Net Worth Banking will be more concerned with the ability of the staff to be responsive to their demanding customer's requests.

Likewise the customer service skills needed in the Call Centre environment are not required to the same degree in Credit Control

Identifying the differences in the 4 back office operations will lead to a number of different decisions in the design and running of the operation.

Location decisions will be affected – The High Net Worth Unit will need to be close to customers and therefore local outlets will probably be the case. The Voucher Processing Unit does not need access to their customers but as the unit requires the actual voucher to process and bearing in mind the small operating window then it must be within a certain range of its suppliers. The call centre and credit control units could be located anywhere.

The size of operation will be connected to the location decision. The High Net Worth Unit will probably be small, the Call Centre and Credit Control units can make use of economies of scale. The Voucher Processing Unit is more difficult as it has to be sufficiently local to receive and process the vouchers but also large enough to make use of their large machines and create continuous flow that is required in a high volume low variety operation.

Likewise the staff's skills will need to be different. In the High Net Worth Unit staff will need to be flexible to deal with the high variety and also possess customer service skills of the highest order. This will not need to be the case in the Voucher Processing Unit.

Each of the units have some variation of demand. In all cases managing this degree of variation is important. In operations such as these in Financial Services the key to managing demand is usually connected to the flexibility of the staff. In the High Net Worth Unit in particular the staff will need to be multi-skilled and a good deal of thought will need to go into



the staff scheduling to ensure that the unit can still provide the high level of customer service required at times of peak demand.

Approaches to controlling the operations are likely to vary. There is more likely to be a greater reliance on approaches such as SPC in those operations where the volume is higher. Conversely, project management type skills are likely to be more widely required in units where there is low volume and high variety.

The list could go on. The importance is that students are able to play with a framework such as the 4Vs to give a greater insight into the practical issues of managing an operation.

## **Design House Partnerships at Concept Design Services**

"I can't believe how much we have changed in a relatively short time. From being an inward looking manufacturer, we became a customer focused 'design and make' operation. Now we are an integrated service provider. Most of our new business comes from the partnerships we have formed with design houses. In effect, we design products jointly with specialist design houses that have a well-known brand, and offer them a complete service of manufacturing and distribution. In many ways we are now a 'business-to-business' company rather than a 'business-to-consumer' company." (Jim Thompson, CEO, Concept Design Services (CDS))

CDS had become one of Europe's most profitable homeware businesses. Originally founded in the 1960s, the company had moved from making industrial mouldings, mainly in the Aerospace sector, and some cheap 'homeware' items such as buckets and dustpans, sold under the 'Focus' brand name, to making very high quality (expensive) stylish homewares with a high 'design value'.

### **The move into 'Concept' products**

The move into higher margin homeware had been masterminded by Linda Fleet, CDS's Marketing Director, who had previously worked for a large retail chain of paint and wallpaper retailers. *"Experience in the decorative products industry had taught me the importance of fashion and product development, even in mundane products such as paint. Premium-priced colours and new textures would become popular for one or two years, supported by appropriate promotion and features in lifestyle magazines. The manufacturers and retailers who created and supported these products were dramatically more profitable than those who simply provided standard ranges. Instinctively, I felt that this must also apply to homeware. We decided to develop a whole co-ordinated range of such items, and to open up a new distribution network for them to serve up-market stores, kitchen equipment and speciality retailers. Within a year of launching our first new range of kitchen homeware under the 'Concept' brand name, we had over 3000 retail outlets signed up, provided with point-of-sale display facilities. Press coverage generated an enormous interest which was reinforced by the product placement on several TV cookery and 'life style' programmes. We soon developed an entirely new market and within two years 'concept' products were providing over 75 per cent of our revenue and 90 percent of our profits. The price realisation of Concept products is many times higher than for the Focus range. To keep ahead we launched new ranges at regular intervals.*

## **The move to the Design House partnerships**

*Over the last four years, we have been designing, manufacturing and distributing products for some of the more prestigious design houses. This sort of business is likely to grow, especially in Europe where the design houses appreciate our ability to offer a full service. We can design products in conjunction with their own design staff and offer them a level of manufacturing expertise they can't get elsewhere. More significantly, we can offer a distribution service which is tailored to their needs. From the customer's point of view the distribution arrangements appear to belong to the design house itself. In fact they are based exclusively on our own call centre, warehouse and distribution resources."*

The most successful collaboration was with Villessi, the Italian designers. Generally it was CDS's design expertise which was attractive to 'design house' partners. Not only did CDS employ professionally respected designers, they had also acquired a reputation for being able to translate difficult technical designs into manufacturable and saleable products. Design house partnerships usually involved relatively long lead times but produced unique products with very high margins, nearly always carrying the design house's brand. *"This type of relationship plays to our strengths. Our design expertise gains us entry to the partnership but we are soon valued equally for our marketing, distribution and manufacturing competence."* (Linda Fleet, Marketing Director)

## **Manufacturing operations**

All manufacturing was carried out in a facility located 20km from Head Office. Its moulding area housed large injection-moulding machines; most with robotic material handling capabilities. Products and components passed to the packing hall, where they were assembled and inspected. The newer more complex products often had to move from moulding to assembly and then back again for further moulding. All products followed the same broad process route but with more products needing several progressive moulding and assembly stages, there was an increase in 'process flow re-cycling' which was adding complexity. One idea was to devote a separate cell to the newer and more complex products until they had 'bedded in'. This cell could also be used for testing new moulds. However, it would need investment in extra capacity that would not always be fully utilised. After manufacture, products were packed and stored in the adjacent distribution centre.

*"When we moved into making the higher margin 'concept' products, we disposed of most of our older, small injection-moulding machines. Having all larger machines allowed us to use large multi-cavity moulds. This increased productivity by allowing us to produce several products, or components, each machine cycle. It also allowed us to use high quality and complex moulds which, although cumbersome and more difficult to changeover, gave a very high quality product. For example, with the same labour we could make three items per minute on the old machines, and 18 items per minute on the modern ones using multi moulds. That's a 600 per cent increase in productivity. We also achieved high dimensional accuracy, excellent surface finish, and extreme consistency of colour. We could do this because of our expertise derived from years making aerospace products. Also, by standardising on single large machines, any mould could fit any machine. This was an ideal situation from a planning perspective, as we were often asked to make small runs of Concept products at short notice."* (Grant Williams, CDS Operations Manager)

Increasing volume and a desire to reduce cost had resulted in CDS subcontracting much of its Focus products to other (usually smaller) moulding companies. *"We would never do it with any complex or Design House partner products, but it should allow us to reduce the cost of making basic products while releasing capacity for higher margin ones. However there have been quite a few 'teething problems'. Coordinating the production schedules is currently a problem, as is agreeing quality standards. To some extent it's our own fault. We didn't realise that subcontracting was a skill in its own right. And although we have got over some of the problems,*

*we still do not have a satisfactory relationship with all of our subcontractors.” (Grant Williams, CDS Operations Manager)*

### **Planning and distribution services**

The distribution services department of the company was regarded as being at the heart of the company's customer service drive. Its purpose was to integrate the efforts of design, manufacturing and sales by planning the flow of products from production, through the distribution centre, to the customer. Sandra White, the Planning Manager, reported to Linda Fleet and was responsible for the scheduling of all manufacturing and distribution, and for maintaining inventory levels for all the warehoused items. *“We try to stick to a preferred production sequence for each machine and mould so as to minimise set-up times by starting on a light colour, and progressing through a sequence to the darkest. We can change colours in 15 minutes, but because our moulds are large and technically complex, mould changes can take up to three hours. Good scheduling is important to maintain high plant utilisation. With a higher variety of complex products, batch sizes have reduced and it has brought down average utilisation. Often we can't stick to schedules. Short-term changes are inevitable in a fashion market. Certainly better forecasts would help...but even our own promotions are sometimes organised at such short notice that we often get caught with stockouts. New products in particular are difficult to forecast, especially when they are 'fashion' items and/or seasonal. Also, I have to schedule production time for new product mould trials; we normally allow 24 hours for the testing of each new mould received, and this has to be done on production machines. Even if we have urgent orders, the needs of the designers always have priority.” (Sandra White)*

Customer orders for Concept and Design House partnership products were taken by the company's sales call centre located next to the warehouse. The individual orders would then be dispatched using the company's own fleet of medium and small distribution vehicles for UK orders, but using carriers for the Continental European market. A standard delivery timetable was used and an 'express delivery' service was offered for those customers prepared to pay a small delivery premium. However, a recent study had shown that almost 40 per cent of express deliveries were initiated by the company rather than customers. Typically this would be to fulfil deliveries of orders containing products out of stock at the time of ordering. The express delivery service was not required for *Focus* products because almost all deliveries were to five large customers. The size of each order was usually very large, with deliveries to customers' own distribution depots. However, although the organisation of *Focus* delivery was relatively straightforward, the consequences of failure were large. Missing a delivery meant upsetting a large customer.

### **Challenges for CDS**

Although the company was financially successful and very well regarded in the homeware industry, there were a number of issues and challenges that it knew it would have to address. The first was the role of the design department and its influence over new product development.

New product development had become particularly important to CDS, especially since they had formed alliances with design houses. This had led to substantial growth in both the size and the influence of the design department, which reported to Linda Fleet. *“Building up and retaining design expertise will be the key to our future. Most of our growth is going to come from the business which will be bought in through the creativity and flair of our designers. Those who can combine creativity with an understanding of our partners' business and design needs can now bring in substantial contracts. The existing business is important of course, but growth will come directly from these peoples' capabilities.” (Linda Fleet)*

But not everyone was so sanguine about the rise of the Design Department. *“It is undeniable that relationships between the designers and other parts of the company have been under strain recently. I suppose it is, to some extent, inevitable. After all, they really do need the freedom to design as they wish. I can understand it when they get frustrated at some of the constraints which we have to work under in the manufacturing or distribution parts of the*

*business. They also should be able to expect a professional level of service from us. Yet the truth is that they make most of the problems themselves. They sometimes don't seem to understand the consequences or implications of their design decisions or the promises they make to the design houses. More seriously they don't really understand that we could actually help them do their job better if they cooperated a bit more. In fact, I now see some of our Design House partners' designers more than I do our own designers. The Villessi designers are always in my factory and we have developed some really good relationships."* (Grant Williams)

The second major issue concerned sales forecasting, and again there were two different views. Grant Williams was convinced that forecasts should be improved. *"Every Friday morning we devise a schedule of production and distribution for the following week. Yet, usually before Tuesday morning, it has had to be significantly changed because of unexpected orders coming in from our customers' weekend sales. This causes tremendous disruption to both manufacturing and distribution operations. If sales could be forecast more accurately we would achieve far high utilization, better customer service, and I believe, significant cost savings."*

However, Linda Fleet saw things differently. *"Look, I do understand Grant's frustration, but after all, this is a fashion business. By definition it is impossible to forecast accurately. In terms of month-by-month sales volumes we are in fact pretty accurate, but trying to make a forecast for every week end every product is almost impossible to do accurately. Sorry, that's just the nature of the business we're in. In fact, although Grant complains about our lack of forecast accuracy, he always does a great job in responding to unexpected customer demand."*

Jim Thompson, the Managing Director, summed up his view of the current situation. *"Particularly significant has been our alliances with the Italian and German design houses. In effect we are positioning ourselves as a complete service partner to the designers. We have a world-class design capability together with manufacturing, order processing, order-taking and distribution services. These abilities allow us to develop genuinely equal partnerships which integrate us into the whole industry's activities"*.

Linda Fleet also saw an increasing role for collaborative arrangements. *"It may be that we are seeing a fundamental change in how we do business within our industry. We have always seen ourselves as primarily a company that satisfies consumer desires through the medium of providing good service to retailers. The new partnership arrangements put us more into the 'business to business' sector. I don't have any problem with this in principle, but I'm a little anxious as to how much it gets us into areas of business beyond our core expertise."*

The final issue which was being debated within the company was longer term, and particularly important. *"The two big changes we have made in this company have both happened because we exploited a strength we already had within the company. Moving into Concept products was only possible because we brought our high-tech precision expertise that we had developed in the aerospace sector into the homeware sector where none of our new competitors could match our manufacturing excellence. Then, when we moved into Design House partnerships we did so because we had a set of designers who could command respect from the world class design houses with whom we formed partnerships. So what is the next move for us? Do we expand globally? We are strong in Europe but nowhere else in the world. Do we extend our design*

*scope into other markets, such as furniture? If so, that would take us into areas where we have no manufacturing expertise. We are great at plastic injection moulding, but if we tried any other manufacturing processes, we would be no better than, and probably worse than, other firms with more experience. So what's the future for us?" (Jim Thompson, CEO CDS).*

### **Questions**

- 1        Why is operations management important in CDS?
- 2        Draw a 4Vs profile for the company's products / services
- 3        What would you recommend to the company if they asked you to advise the in improving their operations?

### **Design House Partnerships at Concept Design Services Teaching Note**

This is quite a complex case in some ways. Its purpose is not to provide students with an opportunity to 'solve a problem'. Rather, it is an introductory case (in spite of its complexity) that can be used to open up a number of issues for discussion. Its overall purpose is to introduce students to the richness and complexity of many problems within operations management.

Three characters are involved in the case study. Linda Fleet is the Head of Marketing, Grant Williams is the Operations Manager, and Jim Thompson is the CEO of the company. Once you are familiar with the case it is sometimes effective to role play one or more of these characters for the benefit of the class, with them asking questions of the characters and the lecturer providing any further detail or clarification through this mechanism. Also, it is useful to use props to illustrate the type of products this company designs, makes, and distributes. For example, bring in a basic plastic bucket to illustrate Focus products, a more expensive 'up-market' item of plastic homeware to illustrate Concept products, and a plastic item from a design house (such as Alessi) to illustrate the Design House partnership products.

#### **Why is operations management so important in this company?**

This is a big question and it is best to tackle it both at a strategic and an operational level.

At a strategic level, operations management has provided the capability, particularly in the design and manufacturing parts of the organization that allows the company to compete so effectively. Draw the students' attention to the final part of the case where the CEO expresses the view that the important changes in the company have come as a result of it being able to deploy and operations superiority of some sort.

At an operational level, one could point out the designs that are cost effective and delivered on time allow the company to be first into the market with new ideas. Products made to high levels of quality, when they are needed, and at reasonable cost will allow the products to be sold effectively and prevent customers' complaints as well as saving the company money. Distribution processes that provide good customer service without excessive stock levels will maximize sales whilst minimizing costs.

Early in the class discussion it is useful to make sure that students understand that there are three types of operation represented in this company.

- A design operation that produces the designs for products, sometimes in cooperation with design house designers.
- Manufacturing operations that actually produce the products.
- Distribution operations that take customer orders at its call centre, assembles the order from the products it keeps in store, and physically distributes the products to the customer.

All of these operations are important to the company because:

- they all contribute to the company's ability to serve its customers and therefore retain old customers and gain new customers.
- all contribute to the company's costs and therefore, if managed efficiently, can reduce the costs for the whole business.
- all, if not managed well, can disrupt the flow of products to customers and negatively impact on the company's reputation.

Another way of answering this question is to look at the contribution of operations management as it is described in Chapter 1. In the chapter, four contributions of the operations function were identified. These are as follows.

- Minimizing cost
- Maximizing revenue
- Avoiding excess investment

- Developing capabilities for future innovation

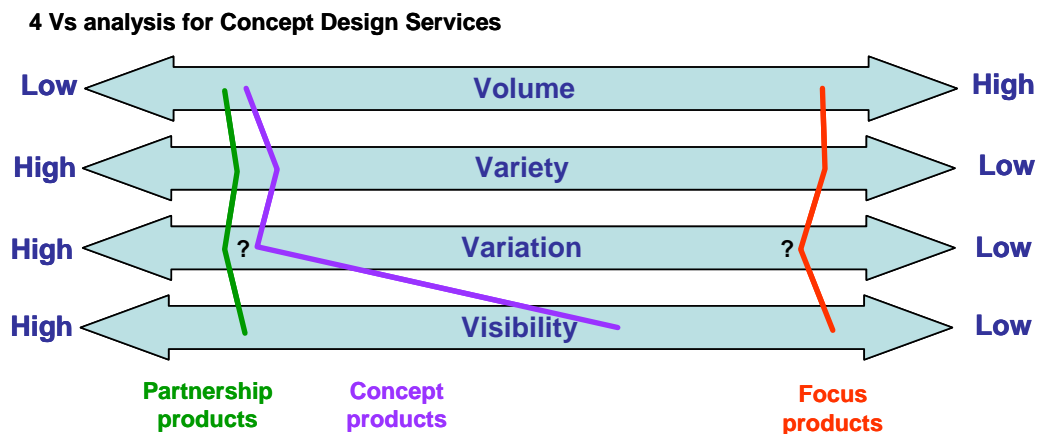
Ask the class how different parts of the company contribute to each of these objectives.

### Draw a 4Vs profile for the company's products / services

#### A four Vs analysis

Although there is not enough information in the case to perform a rigorous four Vs analysis there is enough to make an informed approximation of what the four Vs profiles of the different product group would look like. Start by establishing that the students under the nature of volume, variety, variability, and visibility. Then ask them to describe the company's three main product groups, Focus products, Concept products, and Design House partnership products. After that it could be useful to make a matrix and hold a discussion about what the four Vs mean for each of these product groups. The most difficult is variation because little information is given on this in the case. However, with a little discussion, it becomes clear to students that the basic stable products that represent the Focus group will be less prone to seasonality or sudden fashion changes than either Concept products and Design House partnership products. For both of the latter the fashion element will introduce a degree of risk and uncertainty as to how sales may develop.

The nature of visibility is also a little unclear. Broadly, the company's operations are low or fairly low visibility operations. Yet there are comments in the case that indicate that Design House partnership's require a higher degree of contact with the customer, who in this case is the Design House itself. The company's designers must collaborate with the design houses' designers. Also, Grant comments that the Villessi designers frequently visit Grant's factory.



**What would you recommend to the company if they asked you to advise the in improving their operations?**

This is an opportunity for a general discussion based on the analysis of the first two questions. One way of approaching this question is to ask the class to identify the challenges or problems that are identified in the case. These may include the following.

- The move from a company that sells directly to retailers (Focus and Concept products) to one that sells predominantly to design houses (Design House partnership products).
- The emerging differences between product groups. The Four V's analysis indicated that Focus has a very different four Vs profile when compared to both Concept and Design House partnership products. What are the implications for this in how the company processes these three product groups?
- Are the resources in the company's operations appropriate for these product groups? The main point here is that the type of machines and people necessary to make Focus products (high volume/low variety) may be very different from the kind of machines and people required to process Concept and Design House partnership products. For example, the large machines that the company has recently bought, together with multiple impression moulds seem to be ideal for Focus products that are high volume, low margin, low variety. After all, the disadvantage of these large machines and moulds is that they take a long time to change over between products. Yet there would be relatively few changeovers when making Focus products. By contrast, both Concept and Design House Partnership products are low volume, high variety products that need a far more flexible set of processes to product them. It is unlikely that the large machines and multiple impression moulds used by the company are ideal for this. Therefore, there is some evidence that, in trying to use the same resources to make all its products, it is making life difficult for itself. This is possibly the reason why its schedules need to change so frequently.
- The manufacturing operation seems to be in conflict with the design operation.
- The manufacturing operation seems to be in conflict with the marketing function over the accuracy of its forecasts. Discuss with the class why manufacturing need better forecasts and why marketing may genuinely find it difficult to give them in these circumstances.
- The company admit that they are having some problems subcontracting Focus products. Discuss with the class why this might be and why subcontracting is such a popular option currently.



# Operations Strategy

## 2.1 Introduction

Think carefully before even including this chapter in your course. Clearly it is a vitally important issue for any practising operations manager, but sometimes undergraduates can be confused by the distinction between operations strategy and operations management. The PowerPoint slides for this chapter do include a couple which help to explain the difference, but it can still be confusing. This is partly because there is not such a clear separation between operations management and operations strategy as we sometimes imply. In the operations area especially, we need to include the accumulated learning which comes from day-to-day management of operations resources. This is why this text includes both the bottom-up perspective and the operations resource perspective. Notwithstanding the difficulties, if it is decided to include a session on operations strategy (usually towards the beginning of the course) we have found it best to treat it as a 'backdrop' to the main thrust of the course.

### Key teaching objectives

- To convince students that operations management isn't always 'operational'. Although most of the book does deal with the more operational aspects of the operations function's activities, operations managers have a very significant strategic role to play.
- To stress to students the importance of how the operations function sees its role and contribution within an organisation. ("... you can go into some organisations and their operations function is regarded with derision by the rest of the organisation, how come, they say, that we still can't get it right. This is not the first time we have ever made this product or delivered this service. Surely we should have learned to get it right by this time! The operations people themselves know that they are failures, the organisation does nothing but scream at them, telling them so..... Other companies have operations functions who see themselves as being the ultimate custodian of competitiveness for the company. They are the A team, the professionals, the ones who provide the company with all they need to be the best in the market...")
- To show students that there is a progression of operations excellence (using Hayes and Wheelwright's nomenclature) from Stage 1 to Stage 4.

- To explain that there really is something very important embedded within operations processes. The skills of people within the operation and the processes they operate are the repository of (often years of) accumulated experience and learning.
- To give examples of how markets and operations must be connected in some way. Whether this is operations being developed to support markets, or markets being sought which allow operations capabilities to be leveraged, doesn't matter. The important issue is that there should always be a connection between the two.

## 2.2 Exercises/discussion points

- **Exercise** - Teaching the importance of the strategic role of operations using the Hayes and Wheelwright Stage 1 to 4 model is best done (we have found) by relating it directly to the students' experience. Trying to use the model on a case study we have found to be difficult. Any case study which incorporates all the relevant information would be excessively long. Instead try the following exercise.
- **Teaching tip** - Try establishing the market-operations link by referring to organisations familiar to the students. Even the ubiquitous McDonald's can be used (in fact there is a very good case on McDonald's operations in the Harvard Business School series, contact The Case Clearing House for details). The important issue however is to raise the focus of discussion from managing a single part of the organisation (such as a single McDonald's store) to managing the operations for the whole of the organisation (for example, what are the key operations strategy decisions for McDonald's in the whole of Europe?). The discussion can then focus on the difference between the two levels of analysis. Especially discussion can look at how the operational day-to-day issues (such as, the way staff are scheduled to work at different times in McDonald's stores) can affect the more strategic issues for the organisation as a whole (such as, what levels of service and costs are McDonald's franchise holders expected to work to?).
- **Exercise** - One method of establishing the connection between markets and operations is to ask the class members to find a business-to-consumer website, formally list the 'marketing' promises which the website makes and then think about the operations implications of these promises. For example, what will the company have to do in terms of its inventory management, warehouse locations, relationships with suppliers, transportation, capacity management, and so on in order to fulfil its promises?
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## **2.3 Suggested questions and answers to 'operations in practice' and short cases**

### **Two operations strategies: Flextronics and Ryanair**

Suggested questions....

1. What is the operations strategy of Ryanair, and how does it help to achieve low costs?
2. How does Flextronics' operations strategy help the company to satisfy its customers?
3. What specific operations competencies must Flextronics have in order to make a success of its strategy?

#### **What is the operations strategy of Ryanair, and how does it help to achieve low costs?**

Ryanair, the low cost airlines is an example of an operation that has placed itself at an extreme trade-off position, by sacrificing service functionality for low cost. They also credit Southwest Airlines as the original, and still the best of these focused airlines. Southwest Airlines is the only airline that has been consistently profitable every year for over thirty year. It is also now one of the largest airlines in the world by value. Yet back in 1971 it was upstart three-jet airline operating out of Dallas, Texas (still its headquarters). The strategy of the company has been consistent since it was founded, to get its passengers to their destinations when they want to get there, on time, at the lowest possible fares, and make sure that they have a good time doing it. Its success in achieving this is down to clever management, a relaxed and employee-centred corporate style, and, what was then a unique way of organizing its operations. For over thirty years it has introduced a series of cost saving innovations. Unlike most airlines it provided simple snacks (originally only peanuts) instead of full meals. This not only reduced costs but also reduced turn round time at airports. Because there are no meals there is less mess to clear up and also less time is needed to prepare the galley and load up the aircraft with supplies. Passengers were sold tickets without a seat allocation (simpler and faster) and expected to seat themselves (faster). Originally boarding passes were plastic and reusable and the company was one of the first to use electronic tickets. It was also early in its adoption of the internet to sell tickets directly to passengers. Although most airlines at the time used a range of different aircraft for different purposes, Southwest has consistently stuck with Boeing 737s since it started. This significantly reduces maintenance costs, reduces the number of spare parts needed and makes it easier for pilots to fly any aircraft. Southwest's employee involvement practices are designed to empower employees to take responsibility for maintaining high efficiency and high quality of service with profit sharing plans for almost all employees and innovative stock options plans for its pilots. The result has been what some claim to be the most productive work force in the airline industry.

**How does Flextronics' operations strategy help the company to satisfy its customers?**

The first point to note is that the market for electronic manufacturing services is extremely competitive. Volumes are high but margins are wafer thin. Therefore, any company that is to compete in this market must be sufficiently flexible to take on whatever its brand name customers require it to do, as well as giving fast responsive service and (above all) low costs. If Flextronics' operations can do all these things then it will satisfy its customers and win more business. Unfortunately, product flexibility, fast response, and low costs are often seen as being conflicting objectives. There are clear trade-offs between all three. Flextronics' operations strategy is essentially about how to (at least partially) overcome these trade-offs. This short case deals particularly with trade-off between fast response and low costs. Flextronics has chosen to tackle this through its location strategy. Its industrial parks are set up in relatively low cost locations that are as close as possible to its customers' sites. Very often though, the problem with locating in low cost areas is that, because communications are poor, the delivery of products to customers, and the delivery of supplies from suppliers, may not be as responsive as they should ideally be. This is where the industrial parks strategy comes in. By developing these sites and the associated infrastructure, suppliers can locate along side the Flextronics plants. This allows the company to keep its costs down while still being relatively responsive.

**What specific operations competencies must Flextronics have in order to make a success of its strategy?**

Being able to develop industrial parks is a skill more commonly associated with construction companies and real estate developers than electronics manufacturers. Yet, because of its strategy, these are competencies that must have been developed by Flextronics. So, to make its strategy work, Flextronics must be skilled at most of the following.

- Identifying suitable sites for industrial parks.
- Quickly and efficiently acquiring the land.
- Quickly building facilities to a high standard.
- Starting up production without too many 'learning curve' inefficiencies.
- Persuading suppliers to locate in the park.
- Helping suppliers to ramp-up their own operations efficiently and effectively.
- Integrating the activities of their own and their suppliers' processes to respond effectively to customers' orders.

**Giordano – 'to be the best and the biggest'**

Suggested questions....

1. In what way did Mr Lai's experiences change the market position of his Giordano operation?
2. What are the advantages of sales staff talking to the customers?

**In what way did Mr Lai's experiences change the market position of his Giordano operation?**

When Jimmy Lai first considered the way in which his new retail operation might do business, most of the stores with whom he would be competing offered low prices and very little else to their customers. Presumably by focusing exclusively in low prices those stores were assuming that any increase in service to customers would inevitably mean higher costs and therefore higher prices. Jimmy Lai's great insight was to understand that there was not necessarily a trade-off between good service and low costs. There was no reason why his customers shouldn't have both. At the time this would have been seen as being counterintuitive. Certainly his decision to raise wages by between 30 and 40 per cent would have seemed that way. Similarly, investing in training might have seemed to be a pure 'cost'. In fact better motivated staff, trained appropriately, was what made his stores attractive. The greatly increased volume of business more than covered the extra investment in staff costs. Not only were staff more capable of serving customers, they would be (presumably) happier in their jobs. The atmosphere in the shops created by satisfied staff is something that customers notice. They certainly notice when staff are dissatisfied.

**What are the advantages of sales staff talking to the customers?**

Sales staff are in a better position than almost anybody else within the organisation to really understand what customers respond to. It is sales staff who overhear the conversations between customers and notice customers' behaviour in the shops. Why go to the trouble and expense of organising 'focus groups' when (arguably) more honest reactions can be observed by sales staff.

**Amazon, what exactly is your core competence?**

Suggested question....

Why does this example say something about the idea of core competence?

**Why does this example say something about the idea of core competence?**

This example on the way Jeff Bezos (the founder of Amazon.com) now sees his vast company, is a great example of how the underlying competencies of an organization can come to define what it is. Admittedly, one of the major drivers of Amazon seeing itself as a technology provider has been the seasonality of its demand. Had Amazon not had to cope with this, it might never have been prompted to develop its other services. Nevertheless, it now does see itself as having acquired unique and difficult to replicate competencies that can be leveraged in other markets. Furthermore, these competencies have been developed within its operations function. Only by investing in and developing its information technology, fulfilment processes, and skills over a long period of time could it have done that. Now it can take those competencies into other markets. This is an ideal example of strategy being formed 'inside-out'.

### **Sometimes any plan is better than no plan**

Suggested question....

Why can a plan, even when it is not appropriate, help a strategy to be executed?

#### **Why can a plan, even when it is not appropriate, help a strategy to be executed?**

This is really a debating question. The answer is contained in the short case itself (encouragement, giving purpose, preventing despair, etc.), but it is useful to let a class debate the issue.

## **2.4 Further examples**

### **Kwik-Fit customers' needs**

In an industry not always known for the integrity of its companies, Kwik-Fit has carved out a reputation for service which combines low cost with fast and trustworthy service. Founded in 1971, the company is one of the largest automotive parts repair and replacement firms in the world, with more than 10,000 staff servicing the needs of over 8 million customers through a network of approaching 5,000 service points by 2005. The service dilemma of the company is how to satisfy (or even delight) customers who do not want to be in a repair shop at all. Customers have not planned to have a breakdown; they are making a distress purchase and can often be suspicious of the company. They may believe that it is in the company's interest to recommend an expensive repair or replacement, even when it is not necessary. Customers want to be able to trust the diagnosis and advice they receive, get served as fast and with as

little hassle as possible, have their problem solved and not be charged an excessive amount. These competitive factors have shaped the company's operations performance objectives, summed up in its code of practice.

The people in our centres will always:

- Treat your vehicle with care and always fit protective seat covers.

- Ensure that your vehicle is inspected by a technically qualified staff member.

- Examine the vehicle with you and give an honest appraisal of the work required.

- Give you a binding quotation which includes all associated charges prior to work commencing.

- Ensure you are aware that any non-exchange part or component removed from your vehicle is available for you to take away.

- Ensure that all work is carried out in accordance with the company's laid down procedures.

- Inform you immediately of any complications or delays.

- Ensure that all completed work is checked by a technically qualified staff member.

- Offer to inspect the finished work with you at the time of delivery.

Suggested question....

1. How do customer needs and competitor actions influence the major performance objectives of a Kwik-Fit centre?

### **How do customer needs and competitor actions influence the major performance objectives of a Kwik-Fit centre?**

In fact customer needs and competitor actions are related in this case. Let us take them in turn.

#### **Customer needs**

Customers are often anxious or downright distressed when they seek the service of Kwik-Fit. Their car has broken down or is malfunctioning and they feel vulnerable. More than anything else they want reassurance and professionalism from the operation, transparency of understanding about what is going on, and above all, their car to be fixed.

#### **Competitor actions**

Partly because there are so many small traders in the car repair business, the industry has not always had the best reputation. The idea of the 'cowboy' repairer 'ripping off' the customer is one that is not entirely out of the public's mind. This has increased the importance of reassuring

customers that they are being dealt with in an open, fair and honest manner. Presumably this is why Kwik-Fit spend so much time making sure that their staff understand things from the customer's perspective.

## **Long Ridge Gliding Club**

Long Ridge Gliding Club is a not for profit organisation run by its members. The large grass airfield is located on the crest of a ridge about 400 metres above sea level. It is an ideal place to practice ridge soaring and cross-country flying. The gliders are launched using a winch machine which can propel them from a standing start to around 110 kilometres per hour (70 mph), 300 metres above the airfield, in just five seconds. The club is housed in a set of old farm buildings with simple but comfortable facilities for members. A bar and basic catering services are provided by the club steward and inexpensive bunkrooms are available for club members wishing to stay overnight.

The club has a current membership of nearly 150 pilots who range in ability from novice to expert. While some members have their own gliders, the club has a fleet of three single seater and three twin seater gliders available to its members. The club also offers trial flights to members of the public. (In order to provide insurance cover they actually sell a three month membership with a 'free' flight at the start.). These 'casual flyers' can book flights in advance or just turn up and fly on a first-come, first-served basis. The club sells trial flight gift vouchers which are popular as birthday and Christmas presents. The club's brochure and web site encourage people to:

'Experience the friendly atmosphere and excellent facilities and enjoy the thrill of soaring above Long Ridge's dramatic scenery. For just £70 you could soon be in the air. Phone now or just turn up and our knowledgeable staff will be happy to advise you. We have a team of professional instructors dedicated to make this a really memorable experience.'

The average flight for a trial lesson is around 10 minutes. If the conditions are right the customer may be lucky and get a longer flight although at busy times the instructors may feel under pressure to return to the ground to give another lesson. Sometimes when the weather is poor, low cloud and wind in the wrong direction, almost not fit for flying at all, the instructors still do their best to get people airborne but they are restricted to a 'circuit'; a takeoff, immediate circle and land. This only takes two minutes. Circuits are also used to help novice pilots practice landings and takeoffs. At the other end of the scale many of the club's experienced pilots can travel long distances and fly back to the airfield. The club's record for the longest



flight is 755 kilometres taking off from the club's airfield and landing back on the same airfield eight hours later, never having touched the ground. (They take sandwiches and drinks and a bottle they can use to relieve themselves!)

The club has three part-time employees; a club steward, an office administrator and a mechanic. In the summer months the club also employs a winch driver (for launching the gliders) and two qualified flying instructors. Throughout the whole year essential tasks such as maintaining the gliders, getting them out of the hangar and towing them to the launch point, staffing the winches, keeping the flying log, bringing back gliders, and providing look-out cover is undertaken on a voluntary basis by club members. It takes a minimum of five experienced people (club members) to be able to launch one glider. The club's membership includes ten qualified instructors who, together with the two paid summer instructors, provide instruction in two-seater gliders for the club's members and the casual flyers.

When club members come to fly they are expected to arrive by 9.30 am and be prepared to stay all day to help each other and any casual flyers get airborne while they wait their turn to fly. On a typical summer's day there might be ten club members requiring instruction plus four casual flyers and also six members with their own gliders who have to queue up with the others for a launch hoping for a single long-distance flight. In the winter months there would typically be six members, one casual flyer and six experienced pilots. Club members would hope to have three flights on a good day, with durations of between two and 40 (average ten) minutes per flight depending on conditions. However, if the weather conditions change they may not get a flight. Last year there were 180 days when flying took place, 140 in the 'summer' season and 40 in the 'winter'. Club members are charged a £8.00 winch fee each time they take to the air. In addition, if they are using one of the club's gliders, they are charged 50p per minute that they are in the air.

Bookings for trial flights and general administration are dealt with by the club's administrator who is based in a cabin close to the car park and works most weekday mornings from 9.00 am to 1.00 pm. An answer phone takes messages at other times. The launch point is out of sight and 1.5 km from the cabin but a safe walking route is signposted. Club members can let themselves onto the airfield and drive to the launch point. At the launch point the casual flyers might have to stand and wait for some time until a club member has time to find out what they want. Even when a flight has been pre-booked casual flyers may then be kept waiting, on the exposed and often windy airfield, for up to two hours before their flight depending on how many club members are present. Occasionally they will turn up for a pre-booked trial flight and will be turned away because either the weather is unsuitable or there are not enough club members to get a glider into the air. The casual flyers are encouraged to help out with the routine tasks but

often seem reluctant to do so. After their flight they are left to find their own way back to their cars.

Income from the casual flyers is seen to be small compared to membership income and launch fees but the club's management committee views casual flying as a 'loss leader' to generate club memberships which are £350 per annum. The club used to generate a regular surplus of around £10,000 per year which is used to upgrade the gliders and other facilities. However, insurance costs have risen dramatically due to their crashing and severely damaging four gliders during the last two years. Two of the accidents resulted in the deaths of one member and one casual flyer and serious injuries to three other members.

The club's committee is under some pressure from members to end trial flights because they reduce the number of flights members can have in a day. Some members have complained that they sometimes spend most of their day working to get casual flyers into the air and miss out on flying themselves. Although they provide a useful source of income for the hard-pressed club (around 700 were sold in the previous year), only a handful have been converted into club memberships.

### Questions

- 1 Evaluate the service to club members and casual flyers by completing a table similar to Table 2.1 in the text.
- 2 Chart the five performance objectives to show the differing expectations of club members and casual flyers and compare these with the actual service delivered.
- 3 What advice would you give to the chairman?

### Long Ridge Gliding Club Teaching note

#### 1. Evaluate the service to club members and casual flyers by completing a table similar to Table 2.1.

The needs and expectations of the club members are really quite different from those of the casual flyers. The former are enthusiasts who want to develop their skills in the sport whereas the casuals tend to be one time thrill seekers. Club members just get on with the job and know what to do whereas the casuals need customer service – friendliness, attention, explanation and reassurance.

The trial flights are sold as a loss leader so they can be considered to generate marginal income and profit, with all fixed costs (winches, instructors, clubhouse, office, hangar, gliders, staff etc) allocated to member flights. Indeed these casual flights compensate for the overall loss the club makes on its operations. Its income from trial flights (about £21,000 pa) results in the club making a small annual profit of around £10,000. Despite expecting to attract new members through trial flights less than 5 in 750 (0.7%) result in new members.

Casual members choose gliding because it is available. They might consider hot air ballooning too, for example, if it were available nearby. Price is also important. Since many flights are bought as presents, too high a price would put many off, the current cheap rate (compared to hot air ballooning for example at nearly £80 per person) results in many sales. For the enthusiast the club needs to be within a reasonable travelling distance so they can fly regularly without too much difficulty, so location is critical. Members are concerned about the price of membership and being able to turn up whenever they want. The table below summarises the differences between the casual flyers and the club members.

	<b>CLUB MEMBERS</b>	<b>CASUAL FLYERS</b>
Product	Provision of facilities and instruction to pursue the sport	To experience gliding
Customers	Enthusiasts	Thrill seekers
Product range	Novice to competition gliding	Short introductory flights
Design changes	None	Variety of packages
Delivery	Club/team activity – co-producer of product	Dependable flight
Quality	Good flying conditions	Support, care and attention
Volume per service type	300 members	750 trial flights
Profit margins	Negligible	Mostly profit



Competitive factors

Order winners	Location	Price Availability
Qualifiers	Price Flexibility Dependability	Range of products Quality of service Location
Less important		



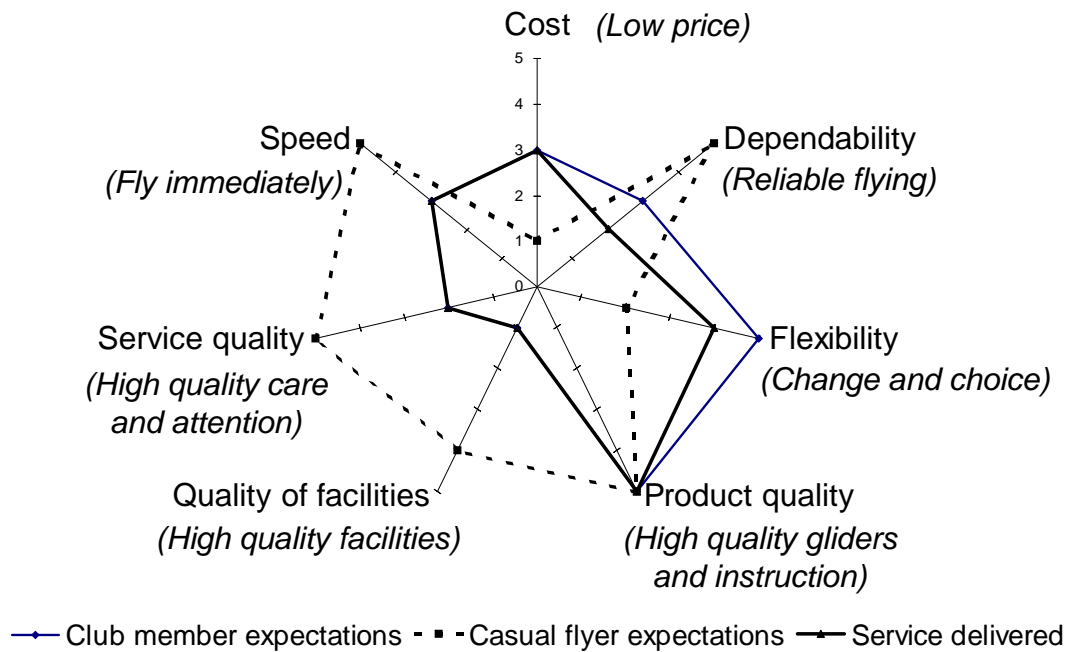
Internal performance objectives	Cost Flexibility Dependability	Speed Dependability Flexibility Quality
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**2. Chart the five performance objectives to show the differing expectations of club members and casual flyers and compare these with the actual service delivered.**

Students will provide a wide range of polar diagrams. This example can be used to demonstrate the need to try to be scientific by devising scales along which agreement about the five performance objectives can be assessed. The tables below show possible scales, their ratings and the resultant polar diagram not only for each customer type but also against the service delivered. ("Quality" refers to product quality, i.e. the gliders and the quality of instruction, the quality of facilities and the quality of service – quality of the pre- and post-flight care.)

	<b>0</b>	<b>5</b>
Cost	high price	low price
Dependability	not likely to be able to fly	able to fly as arranged
Flexibility	single product	do anything anytime
Product quality	dangerous gliders and poor instruction	well maintained gliders and excellent instruction
Quality of facilities	very basic facilities	5* facilities
Service quality	non-existent service	helpful, attentive and available staff
Speed	wait all day	fly immediately

	<b>Club member expectation</b>	<b>Casual flyer expectations</b>	<b>Service delivered</b>
Cost	3	1	3
Dependability	3	5	2
Flexibility	5	2	4
Product quality	5	5	5
Quality of facilities	1	4	1
Service quality	2	5	2
Speed	3	5	3



It is clear that the operation (i.e. the service delivered) is more attuned to the needs of the club members. This should be of no surprise because club members run the operation (through the committee).

Indeed many club members see the casuals as a nuisance who take up their precious air time and reduce instructor availability with little benefit to the club.

- Club members are expected to help for a full day at the club, whereas members of the public are not required to help at all.
- Members hope to fly sometime during the day whereas casuals expect to have a flight almost immediately.
- Casuals have paid for their flight and have to be flown (weather permitting) but members pay after and are not guaranteed a flight.
- Club members can spend 3 or 4 hours on the airfield hard at work flying other club members, members of the public and visiting pilots before they get their turn to fly. In fact, on some occasions the weather conditions change for the worse and they do not get to fly at all.

And, as a result:

- They feel pushed out of flying by casuals
- They consider the club is grabbing money from casuals at the expense of their flying
- They feel that the casuals change the nature of 'club'
- They come and work all day for the benefit of the casuals and may not get a flight
- They feel like cheap labour.

Similarly the casual flyers perceive they have a raw deal:

- They see unfriendly and unhelpful people
- They feel ignored and unloved
- They enjoy the flight but it can be very short (5 minutes)
- They experience very poor service.

The following extract of letter received by the club is not unusual:

"The flight was a 60th birthday present from my wife. I drove to the club with great excitement and apprehension. There was no one in the clubhouse or office and I had no idea where to go. I walked around for a long time and saw people at the far end of a field. When I got there no one spoke to me. I approached a man in a Landrover who reluctantly found someone to fly me. I was in the air for less than five minutes and then pushed out of the plane as soon as we landed."

### **3. What advice would you give to the chairman?**

There are five possible options that could be considered:

1. Do nothing.

By continuing as they are the club will continue to alienate its members for whom the "clubby" atmosphere is key. The club is hard pressed, indeed its membership was declining and if nothing is done the implications could be serious. Casual flyers, although somewhat alienated by their experience, at least get a flight, the thrill they were seeking, though may not recommend it to others. However, with a large population within a few hours drive of the club and substantial numbers of tourists in the area, the numbers of casual flyers may not be at risk. However,

without enough members to launch or fly them the casuals might not even get their quick thrill. This could have a significant effect on the club's reputation.

## 2. End trial flights.

This would certainly make things better in the short term for club members. There would be no casual flyers taking up winch time or more importantly instructor time that the club members could use. The main problem is the reduction in income. The casual flyers are keeping the club afloat, though most members are blissfully unaware of this. To make up for this shortfall and thus pay for the improved service to members, they would either have to pay an additional £70 on membership fee (a 35% increase) or increase launch fees by £3.28 (a 66% increase), for example.

## 3. Create two processes to look after the two types of customers.

By providing dedicated staff and facilities for each customer type, club members and casual members would have their own winch crews, instructors, and experience. Casual members could have administrative staff who greeted them and a warm, pleasant room where they could be met and briefed by their instructor. A minibus could take them to the launch point for their flights and provide some shelter from the wind. Although this appears to be an idealistic solution it is employed at one UK gliding club. It would, however, be inappropriate for Long Ridge as they do not have the staff or finances to support this approach, although the casual flyers might well stand an increase in fees which might pay some of the costs.

## 4. Amend the process

Amend the process to deal better with the casuals without unduly affecting the members. Define the product for the casuals, such as meeting and greeting of the casuals, a flight briefing and an agreed minimum flight time. Inform club members of the (financial) importance of casuals and the need to give them a good experience.

## 5. Better manage casuals' expectations

Bring the casuals' expectations in line with the service delivered. Change the literature to give the impression that they will have to wait, may only get a short flight and are expected to help with winching, and glider preparation. Some possible quotes for the brochure might include:



Cost	£28
Dependability	"We advise a phone call first" "Subject to availability and weather conditions"
Flexibility	"Phone up and we'll see if we can do it"
Quality	"Gliding needs teamwork, the cooperation of all the people involved. Everyone is needed, keeping a log on the field, driving the winches or bringing back gliders" "The club has all the basic necessities"
Speed	"Plan your trial lesson in advance" "Whilst you wait for your flight you have the chance to help the launch crews"

#### Recommendation

A mixture of 4 and 5. This strategy could also help convert more casuals into members.

# Social, environmental and economic performance

## 3.1 Introduction

This chapter deals with the broad idea of operations performance – how well or badly an operation is performing. Although this is a very big subject that spreads over many diverse subject areas (Finance, HRM, Strategy, etc.) we deal with it relatively briefly and obviously from an operations perspective. If time is short, incorporate it in to the introductory lesson with the material from Chapter 1. All of the topics in this chapter are important but the concept of ‘triple bottom line’ can be a difficult one for undergraduates to maintain a balanced view on. We have found that undergraduates with some experience can get something out of the issues in this section but those without any work experience find it difficult.

### ***Key teaching objectives***

- To introduce the ‘triple bottom line’ concept and establish the importance of operation’s contribution to environmental and social as well as economic performance.
- To demonstrate that there is a whole range of performance criteria which can be used to judge an operation and which operations managers influence.  
*(“.....although cost is important and operations managers have a major impact on cost, it is not the only thing that they influence. They influence the quality which delights or disappoints their customers, they influence the speed at which the operation responds to customers’ requests, they influence the way in which the business keeps its delivery promises, they impact on the way an operation can change with changing market requirements or customer preference. All these things have a major impact on the willingness of customers to part with their money. Operations influences revenue as well as costs.”)*
- To demonstrate that for each performance objective there are internal and external benefits.
- To introduce the idea of trade-offs between operations objectives.

### 3.2 Exercises/discussion points

- **Exercise** – Revisit the Oxfam case in chapter 1. Pose the following question to the class. This is one of those cases which can be used either at the beginning or at the end of a course in operations management. If used at the beginning, its purpose would be to demonstrate how operations management is relevant to not-for-profit organisations as well as commercial companies. It could also be used to prompt a discussion of the differences between providing ongoing assistance and development in different parts of the world and the shorter, more dramatic 'projects' associated with emergency relief. Both aspects of operations are important to Oxfam. If used at the end of the course, its purpose could be look at some of the more difficult aspects of how operations practice impacts on the social concerns of a business.
- **Teaching tip** - Teaching the nature and importance of the various performance objectives can be done in two ways.
- One can look at each performance objective in turn using examples of where the particular performance objective has a special significance. So, for example,
  - **Quality** – Use any company which competes especially on quality. High quality hotels and restaurants can be used, as can luxury services such as high price hairdressers, etc. This can prompt a useful discussion regarding what we mean by quality (although you may wish to reserve this for the lesson on quality). Alternatively, use an example where high conformance is necessary for safety reasons such as in hospital blood testing.
  - **Speed** – Any accident, emergency or rescue service is useful to discuss here. The consequences of lack of speed are immediately obvious to most students. Also use transportation examples where different speeds are reflected in the cost of the service. First and second class postage is an obvious example as are some of the over-

night courier services. Likewise, the fast check-in service offered to business class passengers at airports and the exceptionally fast service of Concorde (depending on whether it is flying when you are reading this!) which offers a fast service at a very high price.

- **Dependability** – Some of the best examples to use here are those where there is a fixed ‘delivery’ time for the product or service. Theatrical performances are an obvious example (or the preparation of lectures). Other examples include space exploration projects which rely on launch dates during a narrow astronomical ‘window’.
- **Flexibility** – We have found the best examples here to be those where the operation does not know who or what will ‘walk through the door’ next. The obvious example would be a bespoke tailor who has to be sufficiently flexible to cope with different shapes and sizes of customer and also (just as importantly) different aesthetic tastes and temperaments. A more serious example would be the oil exploration engineers who need to be prepared to cope with whatever geological and environmental conditions they find drilling for oil in the most inhospitable parts of the world. Accident and emergency departments in hospitals can also provide some good discussions. Unless they have a broad range of knowledge which allows them to be flexible they cannot cope with the broad range of conditions presented by their patients.
- **Cost** – We use the example of the low cost retailers such as Aldi who have achieved some success in parts of Europe by restricting the variety of goods they sell and services they offer.
- **Exercise** - The alternative method of teaching performance objectives (and the one we prefer) is to find an example which can be deconstructed using all five performance objectives. Not only can it provoke a debate on the external benefits of each performance objective (why the customers like each of them), it also demonstrates some of the internal connections between the performance objectives (for example, the way staff flexibility allows them to respond quickly to unexpected demand).

### 3.3 Suggested questions and answers to 'operations in practice' and short cases

#### A tale of two terminals

Suggested questions.....

1. *What went wrong with the opening of Heathrow's Terminal 5?*
2. *What did Dubai's Terminal 3 do differently?*

***What went wrong with the opening of Heathrow's Terminal 5?***



***What did Dubai's Terminal 3 do differently?***

**Organically good quality**

Suggested questions.....

1. What does Lower Hurst Farm have to get right to keep the quality of its products and services so high?
2. Why is Nick's point about veterinarian help important for all types of operation?

**What does Lower Hurst Farm have to get right to keep the quality of its products and services so high?**

It is first important to understand what is meant by 'quality' in this case. Of course, it means the same as for any other product, namely that it consistently meets its specification. But also there are other issues with this organisation. First, there is a matter of trust. The people who buy this meat are doing so, at least partly, because it is organic. Therefore, they must trust the operation to maintain everything that is associated with organic farming. This includes both the way the animals are reared and cared for and the stewardship of the countryside. The operation therefore must do everything it can to demonstrate that it is doing this and build the trust of its customers. Second, there is a significant 'quality of service' issue. Catherine points out that customers like to have personal communication with her when they are ordering their meat. Quality of service therefore means not only the courtesy and responsiveness that we would expect from any service, but also the feeling that the customers are 'part of the system'.

Achieving these different aspects of quality means devoting considerable attention to how the farm manages its processes. In effect, there are three processes here, rearing the cattle, butchering the cattle and packing the meat, and order taking and despatch to customers. Rearing the cattle under organic conditions is clearly a rigorous and demand process. The inputs to the process (the land, cattle, feed, absence of artificial fertilisers and drugs etc.) must all be checked for quality and the day-to-day care of the cattle must conform to organic farming rules. The butchering must be done so as not to cause too much distress to the animals and the freezing process is designed (with specialist help) to maintain the quality of the meat. Finally, the ordering process must be conducted, not just with courtesy, but with a level of friendliness appropriate to customers' expectations. Similarly, transportation of the products must be fast and dependable (Catherine always calls customers to make sure that they have received their order and that it is in good condition).

**Why is Nick's point about veterinarian help important for all types of operation?**

Nick distinguishes between how most farmers use veterinarian help (as an emergency service) as opposed to how organic farmers use it (as a method for preventing problems happening in the first place). This issue applies to almost all operations. In detail it is treated in Chapter 19 where we distinguish between preventive maintenance and 'run to breakdown' maintenance.

Nick's view is very close to the modern philosophy that, because the true cost of breakdown in any part of an operation is far higher than most people imagine because of the disruption it causes, it is usually best to try to put some effort into preventing breakdowns happening in the first place.

## **When speed means life or death**

Suggested questions.....

1. Draw a chart which illustrates the stages between an accident occurring and full treatment being made available.
2. What are the key issues (both those mentioned above and any others you can think of) which determine the time taken at each stage?

**Draw a chart which illustrates the stages between an accident occurring and full treatment being made available.**

We don't have enough information to draw any definitive specific chart. But one can choose a typical situation and speculate as to the likely stages.

**What are the key issues (both those mentioned above and any others you can think of) which determine the time taken at each stage?**

Looking at the list of activities above, one can see that minimising the time between each one depends on a number of factors.

- Information flow – The faster information moves between the three parties (the victim, the vehicle with its staff and the hospital) the faster decision processes can start. Automated systems of accident notification, such as that described in the box, are useful but more common means such as the advent of widespread mobile phone ownership will have helped reduce information transmission times.
- Decision making – Although partly dependent on the quality of information provided, it is important that all staff are trained to make decisions (in this case usually diagnostic decisions) as quickly as possible. Training will need to be designed to promote fast and accurate diagnostic decision making.
- Skills availability – This is related to the above point, if the necessary skills are available in the vehicle diagnosis and treatment can be speeded up. At its extreme this would involve a full medical team and all equipment being carried on board the vehicle. But this is clearly impractical. However, the decision on

what skills to have aboard the vehicle (there are doctors carried on the helicopter) and what equipment to have on board (a trade-off between weight and availability of equipment on the helicopter) are key issues.

- Journey times – The location of hospitals at heavy accident areas can reduce journey times. Probably the most significant move of recent years is to position ambulances away from their home base and near potential accident zones, as mentioned in the box (it's a lot cheaper than moving hospitals).
- Capacity management – The problem with accidents is that they cannot be planned in advance. Some times are known for being dangerous (a rainy Friday evening when people are returning home from work for example). But there will always be some element of uncertainty. Providing plenty of resources to cover during such times minimises the chance that ambulances, doctors etc. will be busy, but this will obviously be expensive. To some extent this decision will always come down to how much, as a society, we are willing to pay to minimise accident trauma.

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### **Dabbawalas hit 99.9999% dependability**

Suggested questions.....

1. Why does the Dabbawalas' service offer such amazing dependability?
2. Do you think that they should be using more information technology to help them get even better?
3. What do you think are the main threats to this service?

### **Why does the Dabbawalas' service offer such amazing dependability?**

Amongst the points that may be relevant are...

- It is an innovative service that meets a real need – it really matters to customers that this service works well.
- If any part of the logistics chain is late on any day, the effects are *immediately* noticed. You don't have to wait to see how well you are doing.
- There is simplicity of organization, without complicated managerial structures.
- The service is repeated in (more or less) the same way every day. Repetition breeds competence.
- There is a local team spirit and emphasis on time management.
- It is a lean low cost operation where any lateness immediately shows in the cost of delivering the service.
- Customer feedback is instant.



- There is a low attrition rate amongst staff. Learning stays in the operation.

**Do you think that they should be using more information technology to help them get even better?**

There may be some improvements to be gained from IT, but any investments must not interfere with what makes the operation great – its team spirit and culture of taking responsibility for great service. Also IT is expensive, but in India labour is not.

**What do you think are the main threats to this service?**

- Amongst the points that may be relevant are...
- There is a high reliance on the dependability of the local train service which is outside of the operation's control.
- The limited education of its staff is currently (in some ways) an asset, but it makes it difficult for the operation to respond to changes.
- The indirect competitive threat probably comes from local caterers, especially as cast-based and conservative eating tastes become less important.
- The rail service may acquire other, more profitable, business to fill its non-peak capacity.

**Flexibility and dependability in the newsroom**

Suggested questions.....

1. What do the five performance objectives mean for an operation such as the BBC's newsroom?
2. How do these performance objectives influence each other?

**What do the five performance objectives mean for an operation such as the BBC's newsroom?**

- Quality – primarily means that the news report is fair and accurate but also means that video downloads and link ups etc. work seamlessly.
- Speed – means that any 'breaking' news can be covered quickly by a journalist and his or her report transmitted back to the newsroom quickly.

- Dependability – means that the news bulletin can go out on time. Most television stations programme their news at set times of day. Being late is not an option.
- Flexibility – means being able to hold several news stories together with video reports and make the decision about which to include and in what order as late as possible.
- Cost – means being able to do all the above without an army of news reporters, camera operators, presenters, studio technicians and so on.

#### **How do these performance objectives influence each other?**

They are all related to some extent but the relationship which is highlighted in the box is that between flexibility and dependability (with some quality thrown in). In effect the argument being made is that the latest video handling technology enables the most appropriate mix of stories (highest quality programme) to be broadcast with absolute dependability.

### **Everyday low prices at Aldi**

Suggested question.....

1. What are the main ways in which Aldi operations try to minimize their costs?

#### **What are the main ways in which Aldi operations try to minimize their costs?**

Aldi do two sets of complementary things to keep their costs down; they minimise input costs and they reduce process complexity.

Minimising input costs includes specialising in 'private label', that is Aldi branded products. This means that they can specify the composition (for example, recipe) of products to keep costs under control. Nor do they have to support the brand marketing that is necessary with branded products. They are also a large organisation who can order products in very large quantities thereby keeping prices down. Nor do they use complex and costly fittings in their stores. Using 'open carton' displays and deliberately not supplying grocery bags both eliminate costs that other supermarkets incur.

The system is also simple. An ordering and stock management system that only has to cope with 700 items is much easier to design and operate than one which has to cope with 30,000 items. Supply chain, stock movement, quality management and other systems are therefore

simpler and cheaper. By using simple customer management devices such as the returnable deposit only when a cart is brought back to the store, the job of collecting and returning trolleys is eliminated.

### **3.4 Further examples**

#### **Being cheap is our speciality**

Hon Hai Precision Industry is sometimes called the biggest company you have never heard of. Yet it is one of the world's largest contract electronics manufacturers who product many of the world's computer, consumer electronics, and communications products for customers such as Apple, Dell, Nokia, and Sony. Since it was founded in 1974, the company's growth has been phenomenal. It is now the world's biggest contract manufacturer for the electronics industry. Why? Because it can make these products cheaper than its rivals. In fact, the company is known for having an obsession with cutting its costs. Unlike some of its rivals, it has no imposing headquarters. The company is run from a five-storey concrete factory in a grimy suburb of Taipei and its annual meeting is held in the staff canteen. "Doing anything else would be spending your money. Cheap is our speciality", says Chairman Terry Gow, and he is regarded as having made Hon Hai the most effective company in his industry at controlling costs. The extra business this has brought has enabled the company to achieve economies of scale above those of their competitors. It has also expanded into making more of the components that go into its products than its competitors. Perhaps most significantly, Hon Hai has moved much of its manufacturing into China and other low-cost areas with plants in South-East Asia, Eastern Europe, and Latin American. In China alone, it employs 100,000 people, and with wages rates as low as one fifth of those in Taiwan many of Hon Hai's competitors have also shifted their production into China.

#### **Being cheap is our speciality Teaching note**

Suggested questions.....

1. Identify the various ways in which Hon Hai has kept its costs low.
2. How easy will it be for Hon Hai's competitors to copy the way it has kept its costs low?

**Identify the various ways in which Hon Hai has kept its costs low.**

Four factors that have a significant impact on operations cost are mentioned in the short case.

- (a) It does not spend money on unnecessary overheads – unimposing corporate headquarters etc.
- (b) Economies of scale – its low prices have brought in more business which increases the volume of output of its factories which in turn reduces the unit cost of producing its products.
- (c) Economies of scale – the company makes many of its own components, presumably because it can do so cheaper than it could buy them from suppliers. In other words, it is retaining the profits from component manufacture itself.
- (d) It makes in low cost locations such as China.

#### **How easy will it be for Hon Hai's competitors to copy the way it has kept its costs low?**

In principle, there is nothing to stop Hon Hai's competitors adopting exactly the same policies. In fact many competitors are doing exactly the same thing. However, remember that Hon Hai has the advantage of doing all these things before many of its competitors even thought about them. When any company tries something new, it will have to learn how to make its strategy work effectively. Hon Hai has more experience of this than its competitors. Nevertheless, it will have to maintain its level of organizational and process learning if it is to stay ahead.

It is also important to note that the cost efficiencies that come from operations and process excellence within the firm are far more difficult to copy than those that derive from simply reducing input costs. For example, Hon Hai gains significant cost advantage from producing in China, but eventually all its competitors will be doing this.

#### **Taxi Stockholm**

Taxi Stockholm may be over 100 years old and organized as a cooperative, but it has become one of the largest and most technically advanced taxi companies in the world. *"They are absolutely trustworthy"*, according to one satisfied customer, *"I am not the only one who chooses them even when they are not first in the taxi queue"*. The company has a policy of choosing reliability over speed according to their CEO Anders Malmqvist. *"Compared to some of our rivals, productivity in our call centre is low. Our workers don't answer as many calls per hour, but that's our choice. The focus of our business is not how many calls we can answer but how many customer we can satisfy."* Such dependability is helped by Taxi Stockholm's automatic routing technology. Phone for a cab and a voice response system identifies your location (verified by pushing the appropriate buttons on the telephone) and the system finds and instructs the nearest available cab to your location. Plans include extending the technology to provide precise estimated times of arrival every time a cab is called and automatic call back to

confirm each reservation. "My job", says Malmqvist "is to get the fleet out when customers demand it, not the other way round".

## **Taxi Stockholm Teaching Note**

Suggested question.....

### **How can Taxi Stockholm keep its dependability high during those times when demand is high and traffic is congested?**

Taxi Stockholm seems to use two methods of keeping their dependability high. First, they ensure a high level of communication with the customer through their call centre. They deliberately do not emphasise productivity so that call centre operatives can keep the customer informed regarding the level of service they should expect to receive (for example, how long they will have to wait for a taxi). This also allows call centre operators to manage customers' expectations. Remember it is not speed that they are competing on but dependability. It is more important to Taxi Stockholm that, even if the taxi will not arrive for half an hour, it really does arrive within half an hour. The second method they use is some very advanced technology. Taxi Stockholm are known for their investment in state-of-the-art identification, positioning and automatic routing technology. Again, this enables the operation to obtain accurate information that helps it to make reasonable estimates of time of arrival and journey times.

## **Operations objectives at the Penang Mutiara**

There are many luxurious hotels in the South-East Asia region but few can compare with the Penang Mutiara, a 440 room top-of-the-market hotel which nestles in the lush greenery of Malaysia's Indian Ocean Coast. Owned by Pemas—OUE of Malaysia and managed by Singapore Mandarin International Hotels, the hotel's General Manager is under no illusions about the importance of running an effective operation. *'Managing a hotel of this size is an immensely complicated task,' he says. 'Our customers have every right to be demanding. They expect first-class service and that's what we have to give them. If we have any problems with managing this operation, the customer sees them immediately and that's the biggest incentive for us to take operations performance seriously. Our quality of service just has to be impeccable. This means dealing with the basics. For example, our staff must be courteous at all times and yet also friendly towards our guests. And of course they must have the knowledge to be able to answer guests' questions. The building and equipment – in fact all the hardware of*

*the operation – must support the luxury atmosphere which we have created in the hotel. Stylish design and top-class materials not only create the right impression but, if we choose them carefully, are also durable so the hotel still looks good over the years. Most of all, though, quality is about anticipating our guests' needs, thinking ahead so you can identify what will delight or irritate a guest.'*

The hotel tries to anticipate guests' needs in a number of ways. For example, if guests have been to the hotel before, staff avoid their having to repeat the information they gave on the previous visit. Reception staff simply check to see if guests have stayed before, retrieve the information and take them straight to their room without irritating delays. Quality of service also means helping guests sort out their own problems. If the airline loses a guest's luggage en route to the hotel, for example, he or she will arrive at the hotel understandably irritated. *'The fact that it is not us who have irritated them is not really the issue. It is our job to make them feel better.'*

Speed, in terms of fast response to customers' requests is something else that is important. *'A guest just should not be kept waiting. If a guest has a request, he or she has that request now so it needs to be sorted out now. This is not always easy but we do our best. For example, if every guest in the hotel tonight decided to call room service and request a meal instead of going to the restaurants, our room service department would obviously be grossly overloaded and customers would have to wait an unacceptably long time before the meals were brought up to their rooms. We cope with this by keeping a close watch on how demand for room service is building up. If we think it's going to get above the level where response time to customers would become unacceptably long, we will call in staff from other restaurants in the hotel. Of course, to do this we have to make sure that our staff are multi-skilled. In fact we have a policy of making sure that restaurant staff can always do more than one job. It's this kind of flexibility which allows us to maintain fast response to the customer.'*

Dependability is also a fundamental principle of a well-managed hotel. *'We must always keep our promises. For example, rooms must be ready on time and accounts must be ready for presentation when a guest departs; the guests expect a dependable service and anything less than full dependability is a legitimate cause for dissatisfaction.'* It is on the grand occasions, however, when dependability is particularly important in the hotel. When staging a banquet, for example, everything has to be on time. Drinks, food, entertainment have to be available exactly as planned. Any deviation from the plan will very soon be noticed by customers. *'It is largely a matter of planning the details and anticipating what could go wrong. Once we've done the planning we can anticipate possible problems and plan how to cope with them, or better still, prevent them from occurring in the first place.'*

Flexibility means a number of things to the hotel. First of all it means that they should be able to meet a guest's requests. *'We never like to say NO!. For example, if a guest asks for some Camembert cheese and we don't have it in stock, we will make sure that someone goes to the supermarket and tries to get it. If, in spite of our best efforts, we can't get any we will negotiate an alternative solution with the guest. This has an important side-effect – it greatly helps us to maintain the motivation of our staff. We are constantly being asked to do the seemingly impossible – yet we do it, and our staff think it's great. We all like to be part of an organization which is capable of achieving the very difficult, if not the impossible.'* Flexibility in the hotel also means the ability to cope with the seasonal fluctuations in demand. They achieve this partly by using temporary part-time staff. In the back-office parts of the hotel this isn't a major problem. In the laundry, for example, it is relatively easy to put on an extra shift in busy periods by increasing staffing levels. However, this is more of a problem in the parts of the hotel that have direct contact with the customer. *'New temporary staff can't be expected to have the same customer contact skills as our more regular staff. Our solution to this is to keep the temporary staff as far in the background as we possibly can and make sure that our skilled, well-trained staff are the ones who usually interact with the customer. So, for example, a waiter who would normally take orders, service the food, and take away the dirty plates would in peak times restrict his or her activities to taking orders and serving the food. The less skilled part of the job, taking away the plates, could be left to temporary staff.'*

As far as cost is concerned, around 60 per cent of the hotel's total operating expenses go on food and beverages, so one obvious way of keeping costs down is by making sure that food is not wasted. Energy costs, at 6 per cent of total operating costs, are also a potential source of saving. However, although cost savings are welcome, the hotel is very careful never to compromise the quality of its service in order to cut costs. *'It is impeccable customer service which gives us our competitive advantage, not price. Good service means that our guests return again and again. At times, around half our guests are people who have been before. The more guests we have, the higher is our utilization of rooms and restaurants, and this is what really keeps cost per guest down and profitability reasonable. So in the end we've come full circle: it's the quality of our service which keeps our volumes high and our costs low.'*

## Questions

- 1 Describe how you think the hotel's management will:
  - (a) Make sure that the way he manages the hotel is appropriate to the way it competes for business;
  - (b) Implement any change in strategy;
  - (c) Develop his operation so that it drives the long-term strategy of the hotel.

- 2        What questions might you ask to judge whether this operation is a stage 1, stage 2, stage 3 or stage 4 operation on Hayes and Wheelwright's scale?
- 3        The case describes how quality, speed, dependability, flexibility and cost impact on the hotel's external customers. Explain how each of these performance objectives might have internal benefits.

### **Operations objectives at the Penang Mutiara Teaching note**

This case describes some aspects of the operations objectives of the Penang Mutiara Hotel, one of the most luxurious resort hotels in South-East Asia. The hotel's objectives are described through extensive quotes from the Manager of the hotel. The operations objectives of the hotel are described in the same order as they are treated in the chapter, namely quality, speed, dependability, flexibility, and cost. Examples are given of what each of these objectives means to the hotel.

This exercise is best used as an introductory exercise towards the beginning of any operations management course. It is a 'soft' exercise in that many of the issues are in the form of opinion (albeit by the chief operations managers of the hotel) and students are probably sufficiently familiar with hotels (if not necessarily of the same class) to speculate. Although the questions to the case exercise refer to operation's role in corporate strategy and the Hayes and Wheelwright Stage 1 to 4 model, the intended use of the case exercise is to give the students practice in identifying the five performance objectives. It is important for them to recognise that there are several dimensions to quality, as well as to the other performance objectives. Asking them to identify what each of the five performance objectives actually means to an operation such as this helps them to understand their multi-dimensional nature.

The exercise may also be extended by asking the students to identify what the various activities of the operations management mean at an operation such as this. For example:

1. What are the design decisions which the hotel's operations managers must make?
2. What do planning and control mean in an operation such as this?
3. How might an operation such as this improve its performance levels?

#### **1. Is the hotel's operations management appropriate for its strategy?**

The key question here is 'how does the hotel compete?' After which one should ask, 'do our operations support this way of competing?'



Hotels such as the Penang Mutiara compete on a global scale against other resort hotels around the world. The Mutiara is at the 'up-market' end of this business, offering high levels of comfort to its guests. Quality of service therefore must be of a high standard although some aspects of quality, such as cleanliness and the state of repair of the furniture and fittings, will be expected to be acceptable by guests and only noticed if they are not acceptable. Other aspects of quality, such as the standard of the food and the level of personal attention, should clearly identify the hotel in the luxury end of the market.

*Can the hotel implement changes in strategy?*

Changes in strategy for the hotel might include such things as:

- Moving into the off-season conference market (requiring the operation to offer different types of service package to different guests).
- Linking with other South-East Asian luxury hotels to offer multi-location holidays (requiring the operation to co-ordinate its reservation system with other hotels and tour operators).
- Extending its services to provide specialist sports and activity holidays (requiring the operation to broaden its range of activities to include specialist instructors and equipment, medical services etc.).

The hotel's main concern (as with any manager of high customer contact operations) will be how to implement such changes so that:

- a. on-going operations are not disrupted and customers inconvenienced;
- b. there are no problems, even at the start of the new services, so customers are well served, even those who are (unwittingly) 'guinea pigs' for the new service.

## **2. Where is the Penang Mutiara on the Stage 1-4 scale?**

- Stage 1 ? - If the manager is to be believed, the Mutiara's standard of operations performance is certainly not holding the operation back from competing effectively.
- Stage 2 ? - Nor is it merely trying to raise its standards of service to those practised in the best resort hotels. Its standards seem to be what one would expect from the best hotels in its class.
- Stage 3 ? - Is the hotel up to the standard of the best in the world? Difficult to tell from one person's (the manager's!) view, but it sounds from the case as though it is.
- Stage 4 ? - Is the operation actually driving the competitive strategy of the organisation? Again, difficult to tell, but if it was it would mean that the excellence of its service and innovation shown by its operations were changing the expectations of customers.

### 3. The Mutiara's external objectives.

**Quality of service** at the hotel will include such aspects as:

- Appearance of fixtures and fittings.
- Cleanliness of the hotel.
- Courtesy and expertise of staff.
- Appearance and taste of food.
- Complimentary 'extras' in rooms.

**Speed** means such aspects as:

- Reporting back to guests on the progress of requests.
- Regular and predictable cleaning times.
- Regular supply of linen, room extras, etc.
- Meals and entertainment happen as advertised.

**Flexibility** means such aspects as:

- Introduction of new services in the hotel.
- Meeting a wide (but defined) range of customer requests.
- Changing the number of staff allocated to particular tasks.
- Adjusting the timing of activities (e.g. room cleaning) to meet customer requests.

**Cost.** Much of the cost base of the hotel will be fixed, in as much as in the short to medium term the cost of staff is largely constant. In the longer term the costs of the building and facilities and their maintenance and upkeep are also difficult to reduce. For this reason the utilisation of the hotel's resources (the 'occupancy' of the hotel) will be a key determinant of profitability. This is why the hotel's operation has such a significant contribution to make in ensuring that the quality of service it provides encourages customers to visit and return to the hotel.

#### **Internal interactions between performance objectives**

The interesting relationships particularly brought out in the case were those between flexibility and quality (responding to a guest's needs when something goes wrong) and speed (moving staff around to respond to changes in demand for services). In addition, flexibility, in terms of responding quickly to, say, a staff shortage in room cleaning, could also help to keep the cleaning task on schedule and hence dependable. Flexibility could also keep staff utilisation high by moving them to where they will be fully and usefully occupied. This maintains staff productivity and hence keeps costs low. Flexibility seems to play a central role in 'enabling' the other performance objectives.

## CHAPTER 4

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# The Design of Services and Products

## 4.1 Introduction

This can be a fun session. All students have bought products and all students have experienced service. Given that customer reaction is an important objective of the design activity, it is easy to use the student group as a sample of consumers and ask them to evaluate alternative designs. Bringing two or three types of the same type of product into the class and prompting a discussion around the design issues involved, is an obvious starting point to discuss design. Similarly, comparing similar but different services which students will have experienced is a possibility. The main purpose is to clearly establish that there are many different alternative designs for any product or service, and that the nature of the design chosen has a very powerful impact on the operations function which has to produce it.

### ***Key teaching objectives***

- To convince students that product and service design is such an important issue in terms of its impact on operations management, and that it should be treated within operations management.
- To establish the importance of design in competitive success.
- To establish the fact that the design of services is just as important (probably more important) as the design of products.
- To emphasise the process nature of product and service design ('All operations are processes which produce some mixture of goods and services. Within any organisation some of its processes will be producing designs for their own products and services. Therefore product and service design is an operation like any other.')
- To examine the overlap between design of products and services on one hand and the design of the processes which produce them on the other.

- To establish some of the general issues in the design process such as the way design processes start with a large number of options and finish with a single selected design, the importance of creativity in the design process, the importance of evaluation (using the criteria of feasibility, acceptability and vulnerability), the use of simulation in design, the increasing importance of environmental issues, and so on.
- To take the students through the various stages of the design process whilst at the same time stressing that describing a process in this way is a great simplification of reality.
- To demonstrate the benefits of interactive design.

## 4.2 Exercises/discussion points

**Teaching tip** – Also, although rather old, we still make extensive use of the Harvard Business School case ‘Benihana of Tokyo’; it is still a great example of the nature of service design.

**Teaching tip** -An alternative to the Benihana case which still uses the same idea is to get students to visit a restaurant, shop or tourist attraction and identify for each, the ‘concept’, the ‘package’ and the ‘process’.

**Teaching tip** - One of the study activities in the chapter suggests that students can visit the web site of the UK’s Design Council ([www.design-council.org.uk](http://www.design-council.org.uk)). This is a great source for examples of good design. Examples and ideas picked up from the site can make excellent illustrations in class and bring a lesson to life.

**Teaching tip** - This issue of sustainability in design is always worth discussing. It may also serve to catch the interest of students (not all of them admittedly). The Centre for Sustainable Designs site ([www.cfsd.org.uk](http://www.cfsd.org.uk)) is useful to find examples that can be used to illustrate a lesson or converted into an exercise.

**Exercise** – Identify a television programme that is reasonably well-known and can be viewed by all students. Ask them to view the programme and then, in groups, prepare a presentation that deals with the design of the programme. Also, ask them to recommend how the design of the

programme could be improved. This is a useful exercise because it encourages students to think about design in a very broad context. Design of a television programme includes not just the appearance of the programme but the way it is structured, the way it has been broken into various parts, the way it can be supported through its web site, and so on. Get them to use the feasibility, acceptability, vulnerability framework to evaluate whatever improvements they recommend.

**Exercise** – Quality function deployment can be relatively complex to use in practice. However, a simple exercise is to choose a service (services work better than products for this exercise) and ask the students to draw up a QFD matrix for it. An obvious service is the course on which the students are registered. Try to guide students into distinguishing clearly between the ‘whats’ (what you want the service to achieve) and the ‘hows’ (the design factors that can be manipulated in order to achieve the service’s objectives).

**Exercise** - Bring in alternative designs for a product with which the students will be familiar. We tend to use food products for this because they are cheap and easily recognised. So, for example, bring in two or three boxes of chocolate assortments and prompt a discussion on the design choices which need to be made. Use the three criteria of aesthetics, usability and produceability. The other advantage of course is that the chocolates can be consumed!

**Teaching tip** -There are plenty of opportunities to use video clips in this subject. In fact there are several programme broadcast on the design process itself, but even if these are not available find a video clip which shows a product or service and then base an exercise around that.

## **4.3 Suggested questions and answers to ‘operations in practice’ and short cases**

### **The troubled history of the Airbus A380**

*Suggested question.....*

1. *What effect did the delays in the introduction of the Airbus A380 have on the costs and reputation of Airbus?*

### **What effect did the delays in the introduction of the Airbus A380 have on the costs and reputation of Airbus?**

Essential the effect of delays of the introduction of the aircraft can be summarised using the concepts expressed in Figure 5.9. For some years prior to the planned introduction, the company had been generating publicity through press releases and advertising campaign. This emphasises the dramatic nature of the plane, being larger and more spacious than anything that had been built previously. It even speculated that its airline customers would want to incorporate such facilities as gyms, crèches for children, bars and restaurants, and so on, in the way they configured the aircraft. This had the effect of creating a great deal of excitement around the new product. Yet, while this publicity campaign was having its most impact, problems started to emerge in the development of the plane. So, not only did late introduction of the aircraft delay the sale of the first aircraft and therefore the revenue coming in to the company, it also generated a great deal of negative publicity. For every story hailing the technical breakthrough that the plane presented, there was one that described the confusion and delays in its design and manufacture. It isn't known exactly how this affected the likelihood that potential future customers were reluctant to place orders, but it is likely that it has some effect on future revenues. Just as important, the considerably extended development and manufacturing time meant that the costs of designing, developing, and manufacturing the plane rose very significantly. It is this combination of reduced revenue and increased costs that pushes back the breakeven time of the product by many years. And, although the Airbus 380 went on to be launched successfully and is still a desirable aircraft with customers waiting to receive their deliveries of the plane, it could have been so much more profitable.

### **Spangler Hoover and Dyson**

*Suggested questions.....*

1. *What was Spangler's mistake?*
2. *What do you think makes 'good design' in markets such as the domestic appliance market?*
3. *Why do you think the two major vacuum cleaner manufacturers rejected Dyson's ideas?*
4. *How did design make Dyson a success?*

#### **1. What was Spangler's mistake?**

Clearly, it was failing to understand the implications of his preliminary design. The spark of creative genius was there but not the ability to fully understand the design's implications or its commercial potential. Had it been, we could be still be talking about 'spanglering' the carpet.

## **2. What do you think makes 'good design' in markets such as the domestic appliance market?**

Three things –

- Aesthetics – the product must look good and reflect the brand value.
- Usability – the product must be easy to use and work well.
- Produceability – the product must be easy to make, or at least not so difficult that costs and quality are compromised.

## **3. Why do you think the two major vacuum cleaner manufacturers rejected Dyson's ideas?**

It depends how charitable you want to be to them. If we are being charitable one could say that Dyson's design represented too much of a risk for the established manufacturers. They would be threatening their own existing products and forgoing the revenue they gained from selling the cleaner bags, for a design which had not been proven in the market place. A less charitable view would be that they were simply conservative, had little imagination, and did not understand the need for innovation. Nor did they understand how a better product, alternatively positioned in the market to stress design and performance, could undermine their existing market position.

## **4. How did design make Dyson a success?**

By systematically challenging the assumptions behind current product orthodoxy. Dyson's design brought together concepts that were not totally original but integrated them and used them in a new context. The ability to do that successfully (and the perseverance) are often far more valuable than pure creative originality. The process of design is essentially about systematically bringing together ideas and subjecting to a critical process.

## **Square watermelons**

*Suggested questions.....*

1. *Why is a square watermelon an advantage?*
2. *What does this example tell us about product design?*

**Why is a square watermelon an advantage?**

The first point to make is that it's a novelty! Such an unusual product will attract attention (and presumably a premium price). Also Japanese grocery stores are much smaller than those in many other parts of the world, and they don't have room to waste. Watermelons, big and round, wasted a lot of space. Most people would simply tell the grocery stores that watermelons grow round and there is nothing that can be done about it. That is how the vast majority of people would respond. But some Japanese farmers took a different approach. If the supermarkets wanted a square watermelon, they asked themselves, "How can we provide one?" It wasn't long before they invented the square watermelon

**What does this example tell us about product design?**

Here are a few of the lessons that have been suggested....

- Don't assume: The major problem was that most people had always seen round watermelons so they automatically assumed that square watermelons were impossible before even thinking about the question. Things that you have been doing a certain way your entire life have taken on the aura of the round watermelon and you likely don't even take the time to consider if there is another way to do it. Breaking yourself from assuming this way can greatly improve your overall life as you are constantly looking for new and better ways to do things.
- Question habits: The best way to tackle these assumptions is to question your habits. If you can make an effort to question the way you do things on a consistent basis, you will find that you can continually improve the way that you live your life. Forming habits when they have been well thought out is usually a positive thing, but most of us have adopted our habits from various people and places without even thinking about them. It's a never ending process, but by doing this, you can consistently strive toward making all aspects of your life more enjoyable instead of defaulting to what you have now.
- Be creative: When faced with a problem, be creative in looking for a solution. This often requires thinking outside the box. Most people who viewed this question likely thought they were being asked how they could genetically alter water melons to grow square which would be a much more difficult process to accomplish. By looking at the question from an alternative perspective, however, the solution was quite simple. Being creative



and looking at things in different ways in all portions of your life will help you find solutions to many problems where others can't see them.

- Look for a better way: The square watermelon question was simply seeking a better and more convenient way to do something. The stores had flagged a problem they were having and asked if a solution was possible. It's impossible to find a better way if you are never asking the question in the first place. Get into the habit of asking yourself, "Is there a better way I could be doing this?" and you will find there often is.
- Impossibilities often aren't: If you begin with the notion that something is impossible, then it obviously will be for you. If, on the other hand, you decide to see if something is possible or not, you will find out through trial and error. Take away the lessons from the square watermelons and apply them to all areas in your life (work, finances, relationships, etc) and you will find that by consistently applying them, you will constantly be improving all aspects of your life.

## **The Daniel Hercheson Blowdry Bar at Top Shop**

Suggested question....

1      *Why is this new service so attractive to the Daniel Hercheson organization?*

### **Why is this new service so attractive to the Daniel Hercheson organization**

There is clearly a market for a service such as this. Prior to Daniel Hersheson introducing the blow dry bar in Top Shop (there are now others in London), it was difficult to simply have wash and blow dry without also having a cut. Hersheson recognised the gap in the market and designed a service to fill it. Partnering with Top Shop also gave the organisation a brand partner that they felt was appropriate in terms of market positioning.

But a new service has to do more than simply fill a market need if it is going to have a significant impact on a business. It also has to fit with existing operational skills or add something new to operations capabilities. This, the blow dry bar manages used to do. Young trainee hairstylists can gain experience of dealing with customers themselves without taking too many risks. Even if a junior stylist makes mistakes in a blow dry, this does not have the permanent effect on a client. So, to some extent, the "pressure is off" the stylist. Yet they gain experience at dealing with clients on their own without too much supervision. This is a valuable attribute that is being developed. It is even known for junior stylists to be promoted to full stylists and bring through the clients who they have got to know in the blow dry bar setting.

## Customizing for kids

Suggested questions.....

### How does the concept of modularization apply to this example?

Each shot from the camera is, in effect, a module or a part of the total programme. By standardizing these modules to emphasise standard shots, it was possible to reuse some modules, even though they were shot in the 'wrong' language.

### What do you think are the similarities between what this company did and how motor vehicle manufacturers design their products?

Essentially, modularization is exactly the same for both industries. In automobile manufacturer it involves standardizing parts so they can be used in several different products. In programme making it involves standardizing shots so that they can be used (with some modification) in different products (that is, the same programme but in a different language).

## 4.4 Further examples

### Customers design their own services

Almost all companies will say that they listen to their customers and find out what they want before they design products and services. However, some experts think that most companies do not go anywhere near far enough in giving customers real influence over the final design. Rather than design *for* customers, increasingly design is being carried out *with* customers, or even *by* customers. There are many opportunities for customers to contribute. For example, some of the 100,000 and more visitors at the Boeing Tour Centre in Everett, Washington, contribute to the design of Boeing aircraft interiors. Boeing, together with Teague, a Seattle firm that designs Boeing airplane interiors, have teamed up to establish the Passenger Experience Research Centre adjacent to the normal tour centre. *"The purpose of the research is twofold",* say the company, *"To influence the design of airplane interiors with input from actual users, and to provide our airline customers with valuable information that will help them select their interiors. We like to do this kind of research to find out what passengers prefer rather than designing interiors according to what we think passengers might want"*. After being measured in an outer lobby, participants are given hand-held remote control devices and shown to their assigned airplane seats. A survey is shown on the screen at the front of the cabin and

participants answer a series of multiple choice questions, submitting their answers using the remote control. *"It's not hard to get volunteers";* say the company, *"People are happy to have a chance to make their preferences known"*.

### ***Suggested questions***

- 1. What do you think are the advantages and disadvantages of involving customers this closely in the design process?*
- 2. How could providers of education 'products' adopt this idea?*

### **What do you think are the advantages and disadvantages of involving customers this closely in the design process?**

The advantages are that customer feedback is real and direct. In many ways, customers know better than anyone what they need and how effective current services are. The disadvantages involve the time taken, the fact that the customers chosen may not be typical, and the general principle that customers have their own agenda which is different from the company's. The company needs to keep its customers happy while being able to make a profit. Customers on the other hand want as much as they can get in return for their effort and money. Therefore their suggestions may not be feasible as far as the company is concerned.

### **How could providers of education products adopt this idea?**

Well, one is faced with the same dilemma. In principle, the customers for education products, such as university degrees, want a good and appropriate education for the time and money they invest in being education. The university or education provider needs to satisfy its customers while still maintaining appropriate standards of assessment and while making a profit (or in a not-profit institution, keeping within its budget). While involving users has significant advantages, there is a limit to how far their wishes can be achieved fairly and economically.

## **Ocean Observations**

Design is not just an important issue for products like the iPod. Even communications service providers are finding that design can make a difference to its customers' perceptions. This is the basis of Swedish company Ocean Observations' success. The company started in web design

when its founders saw a rise in demand for attractive mobile phones, and a market for well designed and packaged content. Now the company designs navigation menus and icons. Sofia Svanteson, CEO and co-founder of Ocean Observations, says Ocean Observations was the first design company of its kind in Sweden and one of the first in Europe. "We saw the similarities between the web and mobile media.

Its first task was to design Samsung's usability graphics, including its icons. She says that the Korean market invests heavily in design and advanced interfaces, both graphically and technically. *"We had to think beyond the normal three-level tree menu that is so popular in mobile phones. So we created something that is similar to a dartboard where the user can navigate vertically, horizontally and circularly."* This fresh thinking started with Samsung and continued with the mobile phone operator '3' in Sweden. It was so pleased that it presented the design idea for all '3' companies around the world. *"The operator has a cool design image,"* Svanteson says. *"Its shops have won interior design prizes in Sweden and its Swedish website is cool and modern. But when we looked at the graphical interface in the mobile phone, we were surprised. It was traditional and boring, with icons that were too detailed, something that does not work well on a small screen or with the 3 brand attributes."* She compares the early mobile industry with the internet. *"In the beginning, the web looked awful and was not very user friendly. The same goes with the mobile phone interface. First everything was black and white and had boring icons. Color screens paved the way for better icons and lively content."*

### **Suggested questions**

1. *How can this case be an example of 'design' when there is nothing 'physical' about a mobile phone navigation system?*
2. *What do you think would be the main objectives of this design assignment?*

### **How can this case be an example of design when there is nothing physical about a mobile phone navigation system?**

Remember what design is. It is devising a concept, a package, and a process for a product or service. This example exhibits all three. Quite clearly, the concept is concerned with aesthetics and usability in the sense that navigation must be easy and intuitive. The package involves the detailed graphical design of the icons together with the navigation rules that allow them to be used. The process is how these icons and navigation rules fit in with the technical functionality of the phone itself.

Design is about how products and services look and how they work. The fact that there is nothing physical there as such is really of no importance.

### **What do you think would be the main objectives of this design assignment?**

As usual we can look at any objectives in terms of quality, speed, dependability, flexibility, and cost. In this case quality is about the usability and the aesthetics of the designs. In particular, aesthetics in this case, must include the essence of how the firm is branding itself and wants to be seen by its customers. The mobile phone market is a fashion market whose products must appeal to whatever market segment is being targeted. Thus the quality of a design is at least partly concerned with how successful the aesthetics of a design are within the context of its target market. In addition, again because of the fashion nature of the market, it must be fast and flexible in responding to market trends. Furthermore, because the navigation screen design is only one part of a very large number of components that make up the product, designs must be delivered dependably so as to fit in with input from other sources. While costs must obviously be controlled, it is unlikely that design costs will be a very significant part of the total cost of the phone.

## **Chatsworth - The Adventure Playground Decision**

Chatsworth, the home of the 12<sup>th</sup> Duke and Duchess of Devonshire, is one of the finest and most palatial houses in the UK, set in over 1000 acres of parkland in the Peak District National Park, England. The original house was built over 400 years ago and rebuilt starting in the 17<sup>th</sup> century. The house is vast, with 175 rooms, lit by over 2000 light bulbs, and with a roof that roof covers 1.3 acres. Chatsworth's many rooms are full of treasures including famous works of art by painters including Rembrandt, and tapestries, sculptures, valuable furniture, musical instruments and even 63 antique clocks which need winding every day. The gardens cover over 105 acres with over five miles of footpaths that guide visitors past fountains, small and large (the largest is 28 metres high), cascades, streams and ponds, all of which are fed by gravity from four large man made lakes on the moors above the grounds. The gardens are a mix of formal and informal areas. There are sculptures, statues, rock gardens, a maze and garden views that constantly change with the seasons; all managed and maintained by a small team of 20 gardeners. Both the House and Gardens are open from March to December and are just two of the experiences available to visitors. Others include an orangery gift shop, restaurant, and farm shop, which are open all year round, and the surrounding park land which is open to visitors for walking, picnics and swimming in the river. The whole estate is owned and managed by an independent charity.

Close to the house and gardens, with a separate admission charge, is the farmyard and adventure playground. The farmyard is a popular attraction for families and provides for close encounters with a variety of livestock including pigs, sheep, cows, chickens, and fish. The staff

provide daily milking demonstrations and animal handling sessions. The woodland adventure playground is accessed through the farmyard and is one of the largest in the country with a range of frames, bridges, high level walkways, swings, chutes and slides.

Simon Seligman is the Promotions and Education Manager at Chatsworth. As head of marketing he is closely involved in the design and development of new services and facilities. He explained the way they do this at Chatsworth. *"It is a pretty abstract and organic process. Looking back over the last 25 years we either take occasional great leaps forward or make frequent little shuffles. The little shuffles tend to be organic changes usually in response to visitor feedback. The great leaps forward have been the few major changes that we decided we wanted to bring about."*

One of those great leaps forward was the decision to replace the children's adventure playground attached to the farmyard, Simon explained. *"The existing adventure playground was clearly coming to the end of its life and it was time to make a decision about what to do with it. It was costing us about £18,000 each winter to maintain it and these costs were increasing year on year. We believed we could get a better one for around £100,000. The trustees asked me, the deputy estate manager with line responsibility for the farmyard and the farmyard manager to form a group and put forward a report to the trustees setting out all the options. We asked ourselves several detailed questions and some fundamental ones too, such as why are we replacing it, and should we replace it at all. We came up with four options, remove it, do nothing, replace with similar, replace with substantially better."*

It was felt that removing the playground altogether was a realistic option. The Duke and Duchess had a view that Chatsworth should be true to its roots and traditions. Whereas one could make an argument for a farmyard being part of a country estate, an adventure playground was considered to fit less well. The down-side would be that the lack of adventure playground, which is a big attraction for families with young children, could have an impact on visitor numbers. However there would be a savings in terms of site maintenance.

The 'do nothing' option would entail patching up the playground each year and absorbing the increasing maintenance costs. This could be a low impact option, in the short term at least. However, it was felt that this option would simply delay the replace/remove decision by five years at most. The current playground was no longer meeting international safety standards so this could be a good opportunity to replace the playground with something similar. It was estimated that a like-for-like replacement would cost around £100,000. Replacing the playground with a substantially better one would entail a much greater cost but could have an impact on visitor numbers. Simon and his team keep a close eye on their competitors and visit

them whenever they can. They reported that several other attractions had first rate adventure playgrounds. Installing a substantially better playground could provide an opportunity for Chatsworth to leapfrog over them and provide something really special.

*“We tried to cost out all four alternatives and estimate what we thought the impact on visitor numbers might be. We presented an interim report to the Duke and the other trustees. We felt that maintaining the status quo was inappropriate and a like-for-like replacement was expensive especially given that it would attract little publicity and few additional visitors. We strongly recommended two options; either remove the playground or go for a great leap forward. The trustees asked us to bear in mind the ‘remove’ option and take a closer look at the ‘substantially better’ option.”*

Three companies were asked to visit the site, propose a new adventure playground and develop a site plan and initial design to a budget of £150,000. All three companies provided some outline proposals for such a figure but they all added that for £200,000 they could provide something really quite special. Furthermore, the team realised that they would have to spend some additional money putting in a new ramp and a lift into the farmyard at an estimated £50,000. It was starting to look like a very expensive project. Simon takes up the story, *“One of the companies came along with a complete idea for the site based on water, which is a recurring theme in the garden at Chatsworth. They had noticed the stream running through the playground and thought it could make a wonderful feature. They told us they were reluctant to put up a single solution but wanted to work with us, really engage with us, to explore what would really work for us and how it could be achieved. They also wanted to take us to visit their German partner who made all the major pieces of equipment. So, over the next few months, together, we worked up a complete proposal for a state-of-the-art adventure playground, including the structural changes in the farmyard. The budget was £250,000. To be honest, it was impossible to know what effect this would have on visitor numbers so in the end we put in a very conservative estimate that suggested that we would make the investment back in seven years. Over the next few years we reckon the playground led to an increase in visitor numbers of 85,000 per year and so we recouped our investment in just three years.”*

#### Questions

1. What do you think comprise the concept, package, and process for the adventure playground?
2. Describe the four options highlighted in the case in terms of their feasibility, acceptability, and vulnerability.
3. What does the concept of interactive design mean for a service such as the adventure playground described here?

## **Chatsworth - The Adventure Playground Decision Teaching note**

### **Introduction**

“Since its earliest beginnings Chatsworth has always undergone changes”, explained the Duke of Devonshire. “What you see now is not how it was 100 years ago, 10 years ago or even one year ago. Changes take place in the house, the garden and in the park, though one must always see these as one, because that is how they were designed and how they should remain. Whenever you change things, there are always those people, me included, who can be concerned or nervous. But we do need to keep changing and we rather relish the challenges change brings and we need to bring along our friends who love Chatsworth with us on those changes.

“We did some market research two years ago and the overwhelming word that was used to describe why people come here was the landscape. This slightly surprised us, maybe because we are all too familiar with it. People say isn't this an amazing place. They don't really mean the house or the garden or the park or the farmyard and playground; people relish the place as a whole and the wonderful countryside in which it sits. Then different people, indeed different members of the same family, will like different bits of it. We don't exactly have a mission statement but the principle purpose of the Trust is for the long term benefit of the public to enjoy Chatsworth House, its garden and park. In order to do this we have to keep the place in good heart and so we need lots of visitors because it costs around £5m a year to run the place and we need to generate this without spoiling the peacefulness and yet at the same time make it interesting. This is an interesting balancing act we have to perform!”

The Playground decision was one such balancing act. The playground is just a very small part of the estate and the visitor experience, indeed a part of the farmyard attraction. It is well used and enjoyed by young children (and their parents) and is one of the few parts of the estate aimed specifically at this younger age group. However an adventure playground is seen by the Trustees to fit somewhat uncomfortably fit with the concept of a country estate. On the other hand, the Trust is keen to cater for all ages; they know that as children grow they may visit Chatsworth with their school to look at the sculptures for example, and then encourage their parents to visit to see the house, later they may enjoy the gardens and then bring their own children to enjoy the farmyard and adventure playground. Further, with the income limited, coming predominantly by visitors' entrance fees and spending in the shops and cafes, there is only so much the Trust can do in any one year to improve their facilities. So a substantial



investment, such as £100,000 or more, in one area would mean that other improvement opportunities would not necessarily be able to go ahead. Thus there was the need for a report to set out the options for the Trustees. At the time the 'remove it' and 'do nothing' options were seen as likely outcomes.

**What do you think makes up the concept, package and process for the adventure playground?**

Students should easily be able to suggest key words that could be included in a service concept, such as (you may like to categorise their answers in terms of nature, use and value):

Nature	safe (ish) play and adventure
Use	children (maybe specifically ages 8-12)
Value	enjoyment, fun

Our suggestion is as follows:

A well-designed adventure playground suited to children aged from 8-12 which provides a challenging, enjoyable but reasonably safe environment for children, on their own or with other children, while being supervised by their parents.

The package of the adventure playground includes many components such as:

For the children:	Climbing frames, bridges, walkways, swings, chutes and slides and 'interesting' access via the 'secret tunnel'
For their parents:	Seating, clear visibility, easy access for pushchairs
For safety:	Ground covered in bark, first aid post

The process is the way in which the concept and package will be delivered to the customer. There are two parts to the process; first the organisation's 'process' and secondly the co-production (with the child(ren) and parent(s)) to enjoy the facility.

The organisation's process includes the inspection of all the equipment in the morning before opening time. Staffing the admission office, café and first aid post, opening the farmyard and playground, providing first aid cover throughout the day, closing the playground and cleaning and tidying the areas ready for the following day.

The children's process is somewhat more freeform, but starts with entering the playground via the secret tunnel, running from one component to the next, asking parent(s) for help, showing parent(s) how high/upside down/stuck they are, and objecting when its time to leave.

**Describe the four options highlighted in the case in terms of feasibility, acceptability and vulnerability.**

We recommend dividing the class into four and asking them to complete part of the grid below for one of the options, ensuring all the options are covered. Allow them to present their findings and maybe have a vote, asking them, if they were a Trustee which option would they go for?

	<b>Feasibility</b> (How difficult is it? What investment will be required?)	<b>Acceptability</b> (Is it worthwhile? What are the returns?)	<b>Vulnerability</b> (What could go wrong? What are the risks?)
<b>Remove it</b>	Relatively easy. It would require several person-days to dismantle it plus removal costs of the equipment.	Having no adventure playground better fits with Chatsworth's concept of country estate. Income would still be gained from entrance fees to the farmyard.	The risk is that there is less (indeed little) for children to do so parents may be much less inclined to visit and in particular not visit again.
<b>Do nothing</b>	The easiest option of all but with increasing maintenance costs.	Visitors continue to pay to use the playground. Income not likely to be affected at least in the short term. This option would allow the decision and investment to be delayed.	In the longer term increasing risk of equipment failing and potentially causing injury.
	Somewhat difficult. This would require	Would minimise the maintenance costs	The equipment may start to appear dated

<b>Replace with similar</b>	removing the old one and replacing it during the closed season. Cost about £100,000.	and keep the equipment in good repair. The returns would be as at present.	(old fashioned) and be less appealing to children who have seen/used newer equipment.
<b>Replace with substantially better</b>	Somewhat difficult. It would require removing the old one and replacing it during the closed season. Cost about £200,000-250,000.	Before the event it was impossible to forecast what the impact would be, at worst, there would be no discernable impact on visitor numbers at all. At best .. who knows?	There are two risks, firstly an untried layout and state-of-the-art equipment and secondly that visitors wouldn't see it as much different than before (therefore have no impact on visitor numbers or at worst not like it and visitor numbers reduce!)

**What does the concept of interactive design mean for a service such as the adventure playground described here?**

Interactive design is about merging the design of the products/services and the processes which create them. In service design it is unusual for these two to be entirely separate. In the case of the adventure playground decision 'interactive design' was brought about in two ways, firstly the creation of Simon's group, including himself as marketing manager, the duty estate manager with line responsibility for the farmyard and adventure playground, and the farmyard manager, to evaluate the options and deliver a report to the Trustees. The second element was the important step taken by the German supplier (they interestingly described as a partner) who encouraged the group to visit their facility (and other sites where similar equipment had been installed) so they could explore the options and develop – together – a plan for the playground and also the process of agreeing it and installing it. This last point helped substantially alleviate the risks that were felt to be associated with the project and were seen as a key reason why the 'substantially better' option was finally adopted.



# Process Design

## 5.1 Introduction

A number of issues are covered in this chapter. It is possible to cover these issues under other headings. For example, some of the chapter could be included in a lesson on product and service design (which is covered in Chapter 4). Similarly, the part of the chapter which deals with volume-variety and its influence on process types could be used as an introduction to process layout (which is covered in Chapter 6). However, we generally find it useful to start out on the 'design' part of an operations management course by having a lesson on 'design' treated in general terms and process design in particular. This is because many students have never thought about design outside its narrow 'product design' meaning. It is important therefore to convince them of the importance of treating design as a broad operations management activity. It is one which applies as much to the design of processes as the design of products and services.

### ***Key teaching objectives***

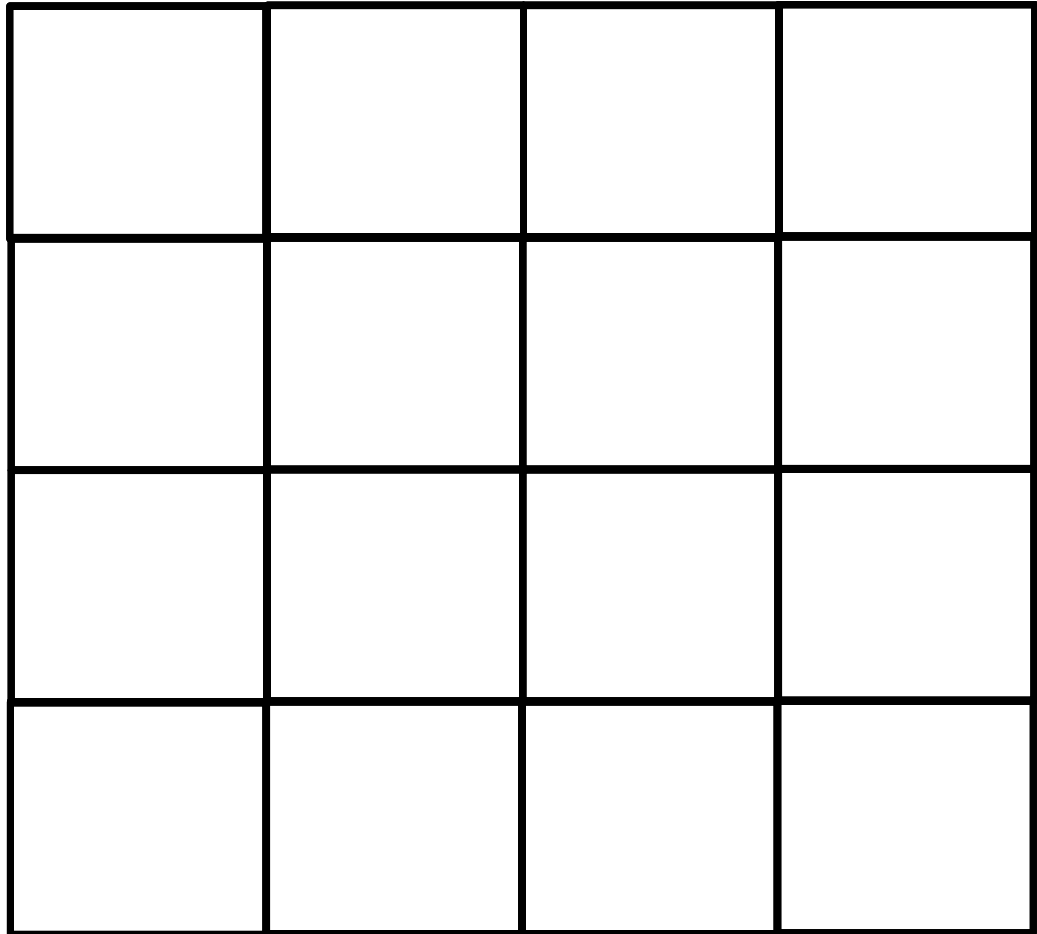
- To convince students of the broad relevance of the design issue to processes as well as products and services.
- To stress the importance of volume and variety in design.
- To introduce the concept of process types.
- To convince students of the broad relevance and importance of the details of process design
- To establish the idea that detailed process design must be connected to the overall objectives of the operation.
- To give experience in simple process mapping.
- To introduce Little's Law as a fundamental law of operations and process management.
- To introduce the implications of variability in process behaviour

## 5.2 Exercises/discussion points

There are many cases and exercises which one could use to introduce operations management. You might like to try some of these ideas, all of which we have used.

- **Teaching tip** - We have found it useful to discuss design in general terms for related products, processes and services so that students can understand how design applies to all three. For example, start by discussing the nature of design for a television. Ask, 'What do we mean by the design of a television?' Students will suggest such things as the overall shape and purpose of the set, its functionality, the components which go into the product, the way the components are connected together and so on. After that, move on to the design of the factory which makes television sets. Again, ask, 'What kind of decisions will need to be made around the design of the factory which makes the TV sets?' Students will suggest a very similar set of issues such as what is the overall purpose of the factory (in terms of its performance objectives), what machines (components) will need to be included within the factory, how are these connected together (in other words what is the flow between the machines) and so on. Finally, describe a company which installs sophisticated television and home movie equipment into (rich) people's homes as a service. In designing this service again, ask, 'What decisions need to be made in the design of this service?' Students will usually suggest things like the limits which define what the service will and won't do, the exact range of equipment they are willing to install, the range of services they offer (including after sales maintenance and so on). They may even understand that the service needs to be able to link different parts of its business together such as purchasing the equipment, installing the equipment, invoicing for payment and so on. By doing this for a product, a process and a service, one can highlight the similarities in the design process.
- **Teaching tip** - We find it useful to encourage students to identify operations with which they are familiar (libraries, shops, restaurants, etc.) and try and classify them as being close to one the pure layout types. Discussions can then centre on how the layout of the operation could be changed to make its flow more or less continuously. The most commonly cited example is a restaurant or eating area within the college or university. Discussions here could involve how to make it more assembly line-like, or more fixed position-like.

- **Teaching tip** - Try discussing with the students how their layout and organisation might change for a simple task such as making a sandwich, as volume and variety change. So, for example, ask the question, "If you were making a sandwich for a friend how would you do it?" Discussion would then centre on the kind of sandwich they want (limited only by the availability of ingredients in the kitchen), when they wanted it (it could be made to order), and how much it could be customised (more salt and pepper?). Then ask, "If you were making sandwiches for a whole group of friends who were due to arrive in an hour's time, how would your process change?" (You would butter all the bread together, standardise the products to some extent, and so on). Then ask, "If you were making 5,000 sandwiches a day for a supermarket, how would you wish to organise the production system?" (Assembly line process, etc.).
- **Teaching tip** – We find that it is usually best to start with a case describing a service rather than manufacturing. This is because service design almost always includes both the design of the process and the design of the service 'product'.
- **Exercise** – Some students may question the necessity for detailed process mapping. In practice of course mapping is necessary to discover exactly what is really happening in a process. The importance of recording the process in the form of a process map reduces any confusion or ambiguity about the process. One way of demonstrating this is to show the figure below for a limited amount of time. Prior to doing this tell the students *"I'm going to show you a figure for 20 seconds. Your task is to follow the instructions on the figure."* Then show the figure (but not for more than 20 seconds) and ask them for the answer.
- You will generally get a whole range of answers. Make no comment at all about which was right or which was wrong. That is not the point of the exercise at all. After you have found the full range of answers simply nod, say thank you and carry on with your next point. Sooner or later (usually sooner) someone will ask, *"What was the right answer?"* Point out that there is no right answer. The instructions actually said, "How many squares do you see in this figure?" The issue is, how many squares do **you** see. The fact that everybody saw a different number of squares emphasizes the need for establishing an agreed set of details about a process in the form of a process map. Otherwise we all see the process in marginally different ways.



How many squares do you see?

- **Teaching tip** – We have found that the issue of series and parallel process configurations (or long-thin versus short-fat processes as we also call them in the text) is something that students respond well too. The Weldon Hand Tool exercise (described in the section of additional cases exercise) is excellent at demonstrating this, especially if one is willing to invest in two or three of the products that can be taken apart. However other, simpler (and cheaper) products such as electrical plugs could also be used to demonstrate the same issue.



- **Teaching tip** – There are many games and exercises available that can be used to demonstrate the reality of process behaviour and the issues that must be tackled in process design. Most of these involve students being formed into teams with a set task to perform. Sometimes this can be a series of arithmetic calculations (useful if many of the students come from financial services). Others involve making simple greetings cards. More complex games may involve using constructions toys such as Lego. Generally, one can find a colleague who has some experience of these games. However, do not dismiss the idea of making one up yourself. Sometimes it is better to have confidence in ones own game than go through a (sometimes embarrassing) learning curve with a game that you have copied from someone else.

## 5.3 Suggested questions and answers to ‘operations in practice’ and short cases

### Fast food drive throughs

Suggested questions.....

1. *How does the Drive-through process decrease throughput time when compared with a conventional Quick Service Restaurant?*
2. *Why should the customer placing orders remotely to a call centre increase the efficiency and speed of the drive-through restaurants that use this process?*

### How does the Drive-through process decrease throughput time when compared with a conventional Quick Service Restaurant?

The obvious saving of time with drive through restaurants is that customers do not have to find a parking space, park their car, walk from the car to the restaurant, choose from the menu, and so on. Instead, they can simply place the order (sometimes restricted) at one window, drive through to the next window where their order has been assembled, then drive off. Of course, there may be queuing at both these windows, but some elements of human interaction are clearly minimized with associated savings in time. This is also a two-stage process as opposed to the combined stage of a normal quick service restaurant. This means there can be some degree of specialisation either in taking an order or in assembling it and taking money. Yet in some ways, partly because of the reduction in human contact time, the process could be seen as being even less flexible than conventional fast-food restaurants. This is probably why drive

through's are encouraging the use of "combo meals". A restricted variety of products will help the drive through process to be even more efficient and fast.

One can also see the use of technology being easier to implement when customers are in their cars. For example, the transponder, or customer recognition, technology that is used on toll roads or at some fuel stations can be used to pay for the meal. For example, a personal transponder in the car, or even car ignition, could be used to eliminate the time taken to request and receive payment for the meal.

**Why should the customer placing orders remotely to a call centre increase the efficiency and speed of the drive-through restaurants that use this process?**

The use of a call centre to take customers' orders may seem odd simply because we, as customers, are used to giving orders to a human being as we approach the drive through restaurant. Yet, actually, we are simply speaking into a microphone. The fact that we can also see the server is incidental. If the microphone is connected to a call centre, that call centre could be almost anywhere in the world (at least hypothetically). The great advantage of having (say) 40 restaurants connected to a common call centre is that it increases the volume of demand at any point in time. Because of the random nature of customers arrivals (see the Queuing supplement at the end of Chapter 11) increasing the scale reduces the chance both of customers having to wait because the order taker is busy, or order takers not having any customers to serve. In other words, the larger the operation, the less one has to trade-off between server utilisation and customer waiting time.

***Ecologically smart***

Suggested questions.....

1. *What are the various objectives that the Smart cars manufacturing processes must achieve?*
2. *Which do you think are the most important objectives?*
3. *By 2006 the Smart car was still not profitable for Daimler-Chrysler. Does this necessarily mean that some process objectives were neglected?*

**What are the various objectives that the Smart cars manufacturing processes must achieve?**

The primary objectives for any automobile plant are cost and quality. In other words, the manufacturing processes must produce error-free cars (that are therefore more reliable in use) and must do so at the minimum possible cost. Minimizing cost usually means minimizing the cost of input resources (such as parts and energy) and ensuring that all the resources within the processes (labour and equipment) are utilized effectively. In addition, because this is a new plant producing a relatively new model of car, it may be that sales forecasts are relatively uncertain. This means that the plant and its processes must be able to meet demand, even when demand is greater than expected. Therefore, volume flexibility may be an important objective.

In addition, the company are clearly interested in the ecological impact of its products and processes. This may well be because of a combination of ethical concerns and the positive publicity that can be generated by emphasizing the car's 'green' credentials.

**Which do you think are the most important objectives?**

Almost certainly cost and quality. No matter how variable the demand, or how important the image of environmental sustainability, the car must still be produced profitably. This means maintaining sales volumes (partly a function of its quality) and keeping its costs down (partly a function of its process efficiency).

However, note that this does not necessarily conflict with environmental objectives. Recycling materials to be used within the car's structure may or may not be less expensive than using new materials, but at least offers the potential for cost savings. Just as important, the emphasis on not wasting energy by focusing on the efficiencies of flow within the factory, both contributes to environmental objectives and saves money for the company. In fact, it is interesting to note how an emphasis on energy movement and material efficiencies make it easier to achieve both cost and environmental objectives.

**By 2006 the Smart car was still not profitable for Daimler-Chrysler. Does this necessarily mean that some process objectives were neglected?**

Not necessarily. As a set of processes the factory may be, in many ways, very well designed. The fact that the product proved not to be as appealing as was hoped is not necessarily a fault of the processes that make it. One could argue however, that more emphasis on designing processes that were volume flexible, that is, they could operate efficiently at very different levels of output, might have meant that the car could be produced profitably even at low volumes.

**Heathrow delays caused by capacity utilization**

Suggested question.....

1. *What could Heathrow airport try to do to reduce the effect of high utilization on its operations?*

### **What could Heathrow airport try to do to reduce the effect of high utilization on its operations?**

The first issue in understanding this example is to fully appreciate why Heathrow has this problem. It is because any little disturbance reduces the available capacity at the airport. Even if this means only a slight reduction in capacity, the utilisation of that capacity will increase because demand has not reduced. Therefore, because utilisation has increased, throughput time will rise dramatically as the curve starts to slope sharply upwards as it approaches 100 per cent utilisation.

Therefore, the only two options available to Heathrow are either to increase the capacity of the airport in some way, or to reduce the amount of variability in the system. Increasing the capacity could be done by increasing the bottleneck stage in the process. In Heathrow's case, this is the number of runways. Currently it has two and there are proposals (fiercely contested by some local and environmental groups) for a third runway. Irrespective of whether one agrees or disagrees with this proposal, it is important to see why the utilisation curve has influenced the airport operators' desire to increase its capacity. Reducing the variability that the operation has to cope with may be possible to some extent, but it's difficult. This would mean ensuring that all aircraft arrive exactly when they are due to arrive, take off exactly when they are due to take off, and any other unplanned disruptions to the smooth running of the airport are minimized. This is a very difficult task. If you have been in an airport you will almost certainly have heard announcements trying to locate passengers who have not yet boarded the plane. Such incidents delay aircraft and can add to the variability in the airport's operations which in turn drives the operation up the utilisation curve and increases delays further.

## **5.4 Further examples**

### **Verenigde Bloemenveiling Aalsmeer (VBA) (United Flower Auctions), Aalsmeer, Holland**

VBA is the largest flower auction operation in the world. It comprises two main parts. The first is the sellers' area known as the 'auction section' where flowers are received, held in cooled

storage areas and auctioned. The second is the 'buyers' section' where around 300 buyers, exporters and wholesalers rent space to prepare flowers for shipment. Trucks leave Aalsmeer every working day with destinations (including airports) throughout Europe. On a typical day there are about 10 000 people working at the centre (1800 of whom work directly for VBA), together handling 17 million cut flowers and two million plants. This large and complex operation is held together by its information processing technology.

Flowers are extremely perishable, so dealing with them in such large quantities makes the speed, accuracy and dependability of the operation critical. During the evening and overnight, flowers are brought into the operation in standard containers which are subsequently handled in standard wheeled cages (there are over 124 000 of these 'trolleys' in circulation – see picture). Each lot of flowers is assigned a reference number, a quality inspection is made by VBA staff, and a description is entered on the 'delivery forms' attached to each trolley. The trolleys are then held in cold storage until they are collected for the auctioning process the following morning.

The auction takes place every weekday in five separate halls, specialized by category of flower or plant. The largest flower auction hall has tiered desks for up to 500 buyers, each linked to the auction computer. Each buyer has an uninterrupted view of the flowers (which are automatically conveyed through the auction halls in their trolleys), and of the four auction price 'clocks' behind the auctioneers. Buyers can then choose the clock of their choice at any time using a selection switch. The auctioneer in charge of each clock may give brief information on the quality of a particular lot, relayed to the appropriate bidders' desk speakers, but most of the important information about the flowers is shown automatically on the clocks' displays (see picture). Flowers are sold by 'Dutch auction', whereby the clock, scaled 100 to 1 at its rim, is started by the auctioneer and moves rapidly downwards. The first bidder to press his desk button stops the clock and becomes the buyer of that lot. This type of bidding is particularly suitable for automation because only one bid needs to be recorded for each transaction. All the details are recorded by computer and printed out on a 'distribution voucher' which is attached to the appropriate trolley. The whole bidding process, including the processing of the information, takes only a few seconds. The lots are then distributed on the trolleys to the appropriate packing or loading areas. For each buyer, the VBA computer prints an invoice for all the purchases made, which must be settled daily by bank letter of credit or by cash drawn at one of the four banks adjacent to the cashier's office.

The high levels of computerization and automation of material flow allow VBA to operate with very low costs (about 5 per cent of turnover), at high speed and dependability. Each of the 13 clocks handles about 1000 transactions per hour. Almost all business takes place between 7.00

am and 10.00 am so that fresh flowers can be in the shops as early as possible – by lunchtime in Holland, by early afternoon in London, Paris and Berlin, and by early morning the next day in New York.

## **Verenigde Bloemenveiling Aalsmeer (VBA) (United Flower Auctions), Aalsmeer, Holland - Teaching note**

Suggested questions...

- 1 Which of the five operations performance objectives (quality, speed, dependability, flexibility and cost) are the most important to build into the design of VBA's process, and why?
- 2 How does process technology help this operation to achieve its objectives?
- 3 Sketch the flow of flowers in the VBA operation. What do you think are the critical points in this flow?

### **Using the case exercise**

The advantage of this case exercise is that it is an unusual operation with many different aspects. It could be used in three ways. The first is as an introductory case relatively early in the course. The various operations issues could then be simply noted as things that will be studied later in the course. The second way is to use it as a specific 'design' case and explore the various design issues within the case. For example, one could use it demonstrate how the operation had placed itself on the '4-Vs' dimensions. The third way of using the case is to use it as a concluding case towards the end of a course. One would here stress the more strategic and overall aspects of the organisation.

### **Which of the five operations performance objectives (quality, speed, dependability, flexibility and cost) are the most important to build into the design of VBA's process and why?**

To some extent, this is a matter of opinion. However, the company itself would place quality very much at the top of the list and flexibility towards the bottom. So, placing the operations objectives in the order which the company would recognise, one can justify their relative importance as follows.

Quality – VBA's service is based on the trust which it has established both with growers and buyers. This involves an implicit guarantee of the quality and freshness of the flowers. For example, VBA invest time and money into the laboratory services which give them the ability to assess flower quality levels. Without this quality guarantee buyers would not be willing to use the service.

**Cost** – Cost is an important objective primarily to the company itself. The whole company's operations are based on high volume. It is, after all, the largest operation of its type in the world. Also, the company have invested in the information technology and materials handling technology which standardises the service, thus reducing costs further. However, cost is also important to the buyers. If the operation were not efficient, then the buyers may find it cheaper to buy directly from the growers. The transaction costs of VBA must be sufficiently low to prevent this happening.

**Dependability** – In this case dependability means that a range and quantity of flowers are available for buyers to purchase if they wish and also that the company are able to guarantee to the growers that flowers will be available for sale at the time promised. Lack of dependability in terms of interruption to the supply of flowers would destroy the trust of both buyers and growers.

**Speed** – Speed is only important up to a point. Obviously the flowers cannot be kept within the total supply chain for too long, otherwise it would reduce their 'shelf life' when they eventually reached the shop. However, after a certain point, no further advantage is gained by rushing the flowers to the market. (Note – while this is generally true, there are some species of plant which, being more delicate, do have to be shipped from growers to the shops relatively quickly.)

**Flexibility** – The flexibility of this operation is not high. If it was they could not achieve the economies of scale and efficiencies of standardisation.

**How does process technology help this operation to achieve its objectives?**

In two main ways. First, the information technology acts as an interface between the buyers and the operation itself. So, while sitting in the auction hall, buyers can indicate (to a fraction of a second) when the price is at a level where they wish to purchase. They are able to do this because information about the flowers has already been conveyed to them electronically and the purchase is able to be recorded because the information system detects their bid and immediately allocates those flowers to their account. This efficient process substitutes for the verbal exchanges and communications which normally take place at an auction. The second way in which technology helps the process is by transporting the flowers from the loading bays through the warehouse to the auction hall and eventually to the trucks which will ship them to their destination. This technology uses standardised trolleys for ease of handling and, again, is integrated with the information technology in order to keep track of which flowers are where.

**Sketch the flow of flowers in the VBA operation. What do you think are the critical points in this flow?**

In fact there is not sufficient information in the case to draw a definitive flow chart. That is not the point of the question. This question is best used to get students to debate what the flow might be and distinguish between the nature of the activities at different stages. So, some stages will be critical. For example, the check-in recording of the flowers as they enter the warehouse and are loaded onto the trolleys is the basis for inspection, acceptance and the documentation of the characteristics of the flowers. It is a point at which failure would have a profound impact on the integrity of the whole system.

### **Process simulation in retail banking**

Retail banking has become a much more competitive business in most markets. Basic banking products, such as current accounts and credit cards, are also now provided by many different financial service companies, insurers, and even supermarkets. This has led to a significant increase in competition between the providers of such services. Increasingly, these companies are having to design operations processes that provide a significantly enhanced service, preferably at lower cost. This is why simulation, once the preserve of expensive and high-tech operational research departments, is rapidly becoming a significant aid to process design in banking operations. It is particularly suited to use in environments where the operational design is complex and therefore expensive to 'try out' for real and also where there is a significant degree of randomness, such as the arrival patterns of customers or the varying length of time taken to serve them. Simulation allows process designers to ask 'what-if' questions for a new design. Alternative designs can be explored at relatively low-cost and low –risk.

The advantage of simulation became clear to Lloyds TSB, one of the UK's most prominent financial services groups, when they used it to help design a new Operational Service Centre . A new centralized operation was created by merging a number of smaller centres. Process design decisions included the number and skills of the people needed to staff the process, what hours they should work, how many terminals and servers to install, the sequence of process activities, how teams should be organized, and so on. The company knew that all these variables were important in determining how the new process would operate, but some variables were likely to have a much more dramatic impact than others. The key question was, which ones?

The computer simulation used by the bank exposed the likely impact of each of these variables in a way that was almost impossible to demonstrate by any other method. In addition, once the model of the new operation had been built, a whole range of processing scenarios could be tried out and their impact assessed in terms of cost, service level and utilization. "Modelling our new operations, particularly with dynamic simulation, has helped us visualize and test a range of



design choices, in a way that we never could before,” says John Tyley of Lloyds TSB, “In particular, it has helped us to deploy process design strategies that have significantly improved the level of service that we provide to our customers. It also gave us a degree of operational transparency before we actually built the new operation. Simulation has been very useful in allowing us to anticipate and reduce operational risk whilst improving our service level to customers”.

## **Process simulation in retail banking - Teaching note**

Suggested questions.....

- 1 List the range of ‘variables’ that you might want to simulate in an operation that processes a car insurance business.
- 2 How would you justify spending large amount of money on building a computer simulation model for a new car assembly plant

**List the range of variables that you might want to simulate in an operation that processes a car insurance business.**

Variables would include the following:

- Number and size of individual call centres
- Different degrees of ability to switch calls between call centres in response to demand variation
- Average level of demand
- Different demand patterns
- Different degrees of unpredictability (short term) of demand
- Average call time
- Distribution of call times around the average
- Change in average and distribution of call times
- Level and variation in absenteeism amongst call centre staff
- Likelihood of disruption to incoming calls
- Ability of operators to satisfactorily answer customer queries
- Different levels of staff IT support (to help them answer customer queries)

**How would you justify spending a large amount of money on building a computer simulation model for a new car assembly plant?**

Any justification would have to be based on the computer simulation's ability to:

- Explore options for the design of the assembly plant

- Highlight potential design flaws that could reduce the efficiency and effectiveness of the plant
- Predict the assembly plant's response to variation in demand and/or the activities it is asked to perform
- The justification must demonstrate that the money spent on the simulation itself will be less than the money saved by improving the design of the plant plus the money saved by the plant being able to change its way of operating in the future.

## **The Central Evaluation Unit**

The Central Evaluation Unit (CEU) of the XIII Directorate evaluated applications from academics bidding for research grants available under the 'cooperation and foundations' scheme of the European Union. This scheme distributed relatively small grants (less than €100,000) to fund the early stages of cooperative research between universities in the European Union. Based in Brussels, the CEU's objectives were to make decisions that were consistently in line with directory guide rules, but also to give as speedy response as possible to applicants. All new applications are sent to the CEUPU by University Liaison Officers (ULOs) who were based at around 150 universities around the EU. Any academic who wanted to apply for a grant needed to submit an application form (downloadable on-line) and other signed documentation through the local ULO. The CEUPU employs three 'checkers' with three support/secretarial staff, a pool of twelve clerks who are responsible for data entry and filing, ten auditors (staff who prepare and issue the grant approval documents), and a special advisor (who is an ex senior officer employed part-time to assess non-standard applications).

Veronique Fontan was the manager in charge of the Central Evaluation Unit's applications processing unit (CEUPU). She had been invited by the Directory chief executive, Leda Grumman, to make a presentation to senior colleagues about the reasons for the success of her unit. The reason for her invitation to the meeting was, firstly, that the systems used for handling new grant applications were well proven and robust, and, secondly, that her operation was well known for consistently meeting, and in many cases exceeding, its targets.

Veronique set a day aside to collect some information about the activities of the CEUPU. She first reviewed her monthly management reports. The information system provided an update of number of applications (by week, month and year), the number and percentage of applications approved, number and percentage of those declined, the and the cumulative amount of money allocated, and the value of applications processed during the month. These reports identified that the Unit dealt with about 300 200 applications per week (the Unit operated a five day 35 hour week) and all the Unit's financial targets were being met. In addition most operational

performance criteria were being exceeded. The targets for turnaround of an application, from receipt of an application to the applicant being informed (excluding time spent waiting for additional information from ULOs) was 40 working days. The average time taken by the CEUPU was working 36 days. Accuracy had never been an issue as all files were thoroughly assessed to ensure that all the relevant and complete data was collected before the applications were processed. Staff productivity was high and there was always plenty of work waiting for processing at each section. A cursory inspection of the sections' in-trays revealed about 130 files in each with just two exceptions. The "receipt" clerks' tray had about 600 files in it and the checkers' tray contained about 220 files.

### **Processing grant applications**

The processing of applications is a lengthy procedure requiring careful examination by checkers trained to make assessments. All applications arriving at the Unit are placed in an in-tray. The incoming application is then opened by one of the eight "receipt" clerks who will check that all the necessary forms have been included in the application. This is then placed in an in-tray pending collection by the coding staff. The two clerks with special responsibility for coding allocate a unique identifier to each application and code the information on the application into the information system.

The application is then given a front sheet, a pro forma, with the identifier in the top corner. The files are then placed in a tray on the senior checkers secretary's desk. As a checker becomes available, the senior secretary provides the next job in the line to the checker. In the case of about half of the applications, the checker returns the file to the checkers secretaries to request the collection of any information that is missing or additional information that is required. The secretaries then write to the applicant and return the file to the "receipt" clerks who place the additional information into the file as it arrives. Once the file is complete it is returned to the checkers for a decision on the grant application. The file is then taken to auditors who prepare the acceptance or rejection documents.

These documents are then sent, with the rest of the file, to the two "despatch" clerks who complete the documents and mail them to the ULO for delivery to the academic who made the application. Each section, clerical, coding, checkers, secretarial, auditing and issuing have trays for incoming work. Files are taken from the bottom of the pile when someone becomes free to ensure that all documents are dealt with in strict order.

Veronique's confidence in her operation was somewhat eroded when she asked for comments from some University liaison officers and staff. One ULO told her of frequent complaints about the delays over the processing of the applications and she felt there was a danger of alienating

some of the best potential applicants to the point where they 'just would not bother applying'.. A second ULO complained that when he telephoned to ascertain the status of an application, the CEUPU staff did not seem to know where it was or how long it might be before a decision would be made. Furthermore he felt that this lack of information was eroding his relationship with potential applicants, some of whom had already decided to apply elsewhere for research funding. Veronique reviewed the levels of applications over the last few years which revealed a decline of five percent last year and two per cent the year before that on the number of applications made. Veronique then spent about ten minutes with four of the clerks. They said their work was clear and routine, but their life was made difficult by University liaison officers who rang in expecting them to be able to tell them the status of an application they had submitted. It could take them hours, sometimes days, to find any individual file. Indeed two of the "receipt" clerks now worked full time on this activity. They also said that University liaison officers frequently complained that decision making seemed to be unusually slow, given the relatively small amounts of money being applied for. Veronique wondered whether, after all, she should agree to make the presentation.

### **Questions**

1. Analyse and evaluate the processing of new applications at the CEUPU:

- Create a process map for new applications
- Calculate the time needed to process an individual application cycle time for the process
- Calculate the number of people involved in the processing of an application
- Explain why it is difficult to locate an individual file.

2. Summarise the problems of the CEUPU process.

3. What suggestions would you make to Veronique to improve her process?

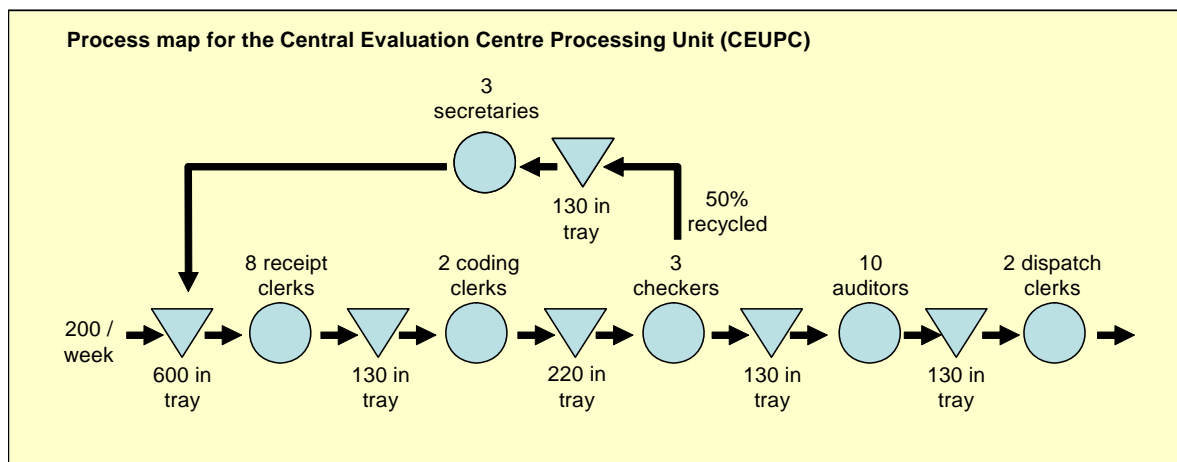
### **The Central Evaluation Unit Processing Centre – Teaching note**

In some ways this is a difficult case although the arithmetic is relatively straightforward. Its purpose is to challenge students to draw a simple process map from a description of a process that (although in rather a confused form) has all the information necessary. The second purpose is to demonstrate how a simple knowledge of Little's Law can reveal something about the process. There is certainly enough information in the case study to allow students to make some preliminary comments on the process and debate how it might be improved.

## 1. Analyze and evaluate the processing of new applications at the CEUPC

### Creating a process map for new applications

From the description in the case, there are clearly a number of sections to the CEUPC and several in-trays that are in effect inventories of applications waiting to be processed. As is often the case, the sections of the centre do not match the processing tasks. So, for example, there are 12 clerical staff, but these are divided into 3 distinct task areas. 8 clerks act as receipt clerks, 2 act as coding clerks, while 2 act as despatch clerks. In process mapping it is important to follow the tasks that are performed on what ever is being processed (in this case the applications for grants). Also from the description there are 6 active in-trays; one for each section, namely clerical (receipt), coding, checkers, secretarial, auditing, and issuing. The diagram below summarizes the process just using the straightforward symbols of an inverted triangle for an inventory and a circle for an operation (any type of operation). It shows that 50 per cent of applications are recycled from the checking operation back to the receipt clerks' in-tray. This will mean that, although 200 applications per week are entering the process, 100 of these are being recycled, so that the effective load on all stages up to and including the checking process will be 300 applications per week. It also implies that some applications are taking much longer because of this recycling. It may be that some applications are recycled more than once.



### Calculation the cycle time for the process

This involves the simple application of Little's Law.

Taking the process as a whole.....

The total work in progress (applications in the in-trays) =  $600 + (4 \times 130) + 220$   
= 1340 applications

Average throughput time = 36 working days

Therefore, from Little's Law

Throughput time = cycle time X work in progress (and  
working in hours)

$36 \times 7$  = cycle time X 1340

Therefore, cycle time =  $(36 \times 7) / 1340 = 0.188$  hours

In other words, a fully processed application form is emerging from the process every 0.188 hours.

That is, in a 35 hour week,

the Centre will process  $35/0.188 = 186.17$  applications per week

This is an important finding because 200 applications per week are entering the process, but only 186.17 applications per week are emerging from the process. In other words, inventory must be building up within the process.

### **Calculate the number of people involved in the processing of an application**

In total there are .....

8 receipt clerks

3 secretarial/support staff

2 coding clerks

3 checkers

10 auditors

2 despatch clerks

1 part-time adviser

This means there are 20 full-time and 1 part-time staff involved in the process.

Ignoring the 1 part-time member of staff, and assuming a 35 hour week, this means that  $20 \times 35$  hours of labour produces 186.17 fully processed applications per week.

Therefore, the number of hours of staff time devoted to each application =  $(20 \times 35) / 186.18 = 3.76$  hours.

But we also know that, on average, an application takes 36 working days (that is  $36 \times 7$  hours) to move through the process.

Therefore, the efficiency of the process =  $3.76 / (36 \times 7) = 1.49$  per cent efficient.

And probably less than that because this figure assumes that everyone works perfectly inefficiently.

#### **Explain why it is difficult to locate an individual file**

Mainly because of all the recycling and the very large inventory of applications. There are simply so many applications in the various in-trays to search through.

#### **Summarize the problems of the CEUPC process**

Although, at a surface level, this process seems to be achieving its objectives, that is only because its main objective of a 40 day average throughput time is very undemanding. There is evidence that there is significant dissatisfaction with the responsiveness of the process. This will be partly because a 40 day target is probably too slow, but also because that the target of 40 days **on average** still means that, because of recycling, many applicants are waiting much longer than this. The process is after all only 1.49 per cent efficient. This means there is a very significant amount of improvement that could be made. Theoretically, an application could move through the process in 3.76 hours, yet it is taking 36 working days.

#### **What suggestions would you make to Veronique to improve her process?**

The main issue is to stop the recycling. There are many ways in which this could be done. Most of them will involve tackling the root cause of the problem, namely that applications are entering the process with insufficient documentation or information. Clearly, an education initiative is needed both to applicants and to the university liaison officers to prevent this happening.

There may also be other inefficiencies in the process to investigate. We know that 3.76 hours are being expended on each application, but how is this time allocated between stages? There may be bottlenecks causing excessive delays before some stages.

Similarly, the amount of variation in the process could be reducing its efficiency. Anything to reduce variability, such as standard ways of working, could help this.





# Layout and Flow

## 6.1 Introduction

This chapter is a mixture of concepts and techniques. As usual the concepts are more important than the techniques. However in this topic particularly, the techniques of layout can be used to reinforce some of the underlying principles behind the concepts. The main concept is that there are specific 'pure' types of layout which relate to process types. The distinction between process types on one hand and layout types on the other can sometimes be confusing to students. The main point to get across is that process types indicate the overall approach to organising an operation. Process is a broader concept than layout. However, layout is what you physically see when you go into an operation. Process is more of a conceptual issue. It is also worth stressing that the relationships between process and layout is not totally deterministic. This point is made in Table 7.1 in the chapter but is worth stressing.

### *Key teaching objectives*

- To identify the main factors on the location decision.
- To introduce the concept of layout type.
- To describe the basic layout types in terms of the nature of the flow of transformed resources through the process.
- To stress that most real layouts are hybrids of the pure types.
- To identify some of the simple approaches that can be used to determine the exact nature of a layout.

## 6.2 Exercises/discussion points

- **Teaching tip** - One way to promote a discussion on location issues is to choose a decision currently in the press. Often this can be a government-originated project such as a sports stadium or museum. The class can then be led through the criteria which may be used to decide on the location.
- **Exercise** - A related but different exercise can be constructed by asking the class to consider how they would make their local area more attractive to incoming business. "If

you were the local government officer in charge of attracting business to this area, what could you do to make the area more attractive?"

- **Teaching tip** - Try contrasting the different approaches to location taken by different types of business. For example, compare the location decision facing a company wishing to build a new factory in a region, with a fast-food restaurant looking for a location in a town where it has no existing outlets. The idea here is to contrast two very different types of location decision.
  1. The new factory location would follow the ideas as set out in the chapter. These tend to assume that location is being chosen primarily on the grounds of minimizing the costs associated with the site. The amount of products sold by the company is unlikely to be very much affected by its location, but its costs could be very much affected by location factors. Furthermore, there are likely to be a very large number of sites that the company could choose from.
  2. The fast-food restaurant, on the other hand, is a different sort of location decision. Both revenue and costs will be affected by location. Locating the restaurant away from other restaurants and/or away from passing trade is likely to mean a reduction in revenue. Some locations are better than others at attracting customers. Also, the costs of the location (such as rent and rates etc.) are affected by location. Finally, there are rarely a large number of options to choose the location from. Usually location is more opportunistic. The fast-food restaurant might wait until a site becomes available and then take the decision as to whether to have that site or to wait in case a better one becomes available.
- **Teaching tip** - We find it useful to encourage students to identify operations with which they are familiar (libraries, shops, restaurants, etc.) and try to classify them as being close to one of the pure layout types. Discussions can then centre on how the layout of the operation could be changed to make it flow more or less continuously. The most commonly cited example is a restaurant or eating area within the college or university. Discussions here could involve how to make it more assembly line-like, or more fixed position-like.
- **Teaching tip** - Try discussing with the students how their layout might change for a simple task such as making a sandwich, as volume and variety change. So, for example, ask the question, *"If you were making a sandwich for a friend how would you do it?"* Discussion would then centre around the kind of sandwich they want (limited only by the availability of ingredients in the kitchen), when they wanted it (it could be made to order), and how much it could be customised (more salt and pepper?). Then ask, *"If you were making sandwiches for a whole group of friends who were due to arrive in an hour's time, how would your process change?"* (You would butter all the bread together, standardise the products to some extent, and so on). Then ask, *"If you were making 5,000 sandwiches a day for a supermarket, how would you wish to organise the production system?"* (Assembly line process, etc.).
- **Teaching tip** - The idea of combinatorial complexity is an important one to get across when dealing with process layouts. Many students do not understand how this works. A good

demonstration is to find someone in the class with a (floating point) calculator, get them to punch in factorial 30 (30!). Then say, *“Supposing that a computer could evaluate and store the details of (say) 10,000 alternative layouts per second. Divide the number, factorial 30, by 10,000 for the number of seconds it would take, divide that by 60 for the number of minutes it would take, divide that by 60 for the number of hours, etc. etc.”* The resulting figure will still be very large. This is why generally good sub-optimal solutions are sought rather than purely optimal ones.

- **Exercise** - Get students to analyse the simple process of boiling an egg or making a cup of tea in their kitchen area. Ask them to relay out the kitchen to make this process more efficient. Get them to discuss the disadvantages as well as the advantages of this.
- **Exercise** - The case study at the end of this chapter ‘Weldon Hand Tools’ we have found to be particularly useful. To make it more interesting, purchase some planes (we have found the Stanley Handyman plane to be the best) and some screwdrivers and let student group take the planes apart. See if they can assemble them in 1.6 minutes (the figure in the case).

## 6.3 Suggested questions and answers to ‘operations in practice’ and short cases

### Tesco’s store flow processes

*Suggested questions.....*

1. *What layout type is a conventional supermarket and how does it differ from a manufacturing operation using the same layout type?*
2. *What are the benefits of supermarkets using customer tracking technology?*

#### **What layout type is a conventional supermarket and how does it differ from a manufacturing operation using the same layout type?**

Essentially a supermarket uses a functional layout. Each area of the supermarket can be seen as being equivalent to a workstation or machine in a manufacturing operation. The transformed resource (customers) flows between various areas depending on their individual needs. So each customer will take a (sometimes marginally) different route through the operation. The biggest difference between the supermarket and an equivalent manufacturing operation concerns the objectives of the layout. In conventional manufacturing operations the objective is usually to minimise the distance travelled in (or time taken to get through) the operation. By contrast, a supermarket’s layout is intended to maximise sales. This is not always the same as maximising the distance travelled (or time taken to get through) the operation, but it will certainly involve a greater time spent looking at, and hopefully buying, products.

#### **What are the benefits of supermarkets using customer tracking technology?**

This type of technology allows supermarkets to:

- Identify and capitalize on opportunities to increase sales and grow margins
- Enhance the customer experience and loyalty through improved service
- Optimize in-store marketing initiatives and traffic patterns
- Implement operational improvements at individual locations or across an entire chain

It gives an accurate view of customer behaviour, with a continuous view of what actually happens when customers are in retail stores. It is able to help with the following.

- Determining customers' movement patterns
- Distinguishing accurately the occurrence of discrete events such as stopping at a digital display, pausing over products, standing in queues, etc.
- Distinguishing between different customers
- Identifying shoppers as distinct from shopping carts
- Capturing data on number of shopping groups versus number of individuals

The information generated from this type of technology can be used to do the following.

- Predict and publish wait times to reduce queue abandonments
- Receive real-time alerts when pre-set targets and volumes are reached
- Plan marketing strategies that are firmly based on shopping habits
- Improve decision making in the near- and long-term
- Identify gaps in staffing and in scheduling
- Identify training opportunities
- Evaluate the effect of layout changes

## **The Tata Nano finds a new home<sup>1</sup>**

*Suggested questions.....*

1. *What seemed to be the advantages and disadvantages of the West Bengal site?*
2. *What must Tata management have thought in selecting West Bengal in 2007?*

### **Background:**

Tata unveiled the cheapest car in the world, Tata Nano in 2007-08. The car caught attention of the world and was hailed as pride of India, bringing a revolutionary design. Tata's vision is to sell this car at a rock bottom price of 100,000 Indian Rupees. The car is designed as a small, value for money car with ability to meet all the latest pollution and safety standards.

Tata chose the site for the new Nano plant as Singur, in the Indian state of West Bengal. West Bengal is a large populous state with its capital as Calcutta (now called Kolkata). For last few decades Communist Party has ruled it with iron hand. It is only one of the 2 states in India to be ruled by Communists for a significant time (other being Kerala in South) and is the only state to be ruled entirely by them for last 4 decades.

### **What seemed to be the advantages and disadvantages of the West Bengal site?**

As far as the site location is concerned, here is the summary of advantages and disadvantages.

#### **Advantages:**

- Cheaper land compared to other industrialised states
- Access to international sea and airport of Calcutta, enabling easy movement of high technology parts and personnel from Japan and also good for export
- Good availability of educated workforce. Bengal education standards are one of the best in the country, helping both the quality of workforce and the incentive for workers' families to come and settle.

#### **Disadvantages:**

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<sup>1</sup> We are extremely grateful to Devendra Damle for this analysis

- Communist party has traditionally opposed entrepreneurship. The state is known for its low economic growth and has stagnated compared to other states in South and West of India. The poverty level is very high.
- The work culture is known to be lazy. It is a joke in other parts in India that in Bengal, you get paid for turning up for work and get overtime if you actually do the work during office hours. The state is known for militancy of unions and is frequently subjected to strikes and state-wide or regional shutdowns (called 'Bandhs' in India)
- Infrastructure – poor on all accounts (power, transport, water) compared to some better industrialised states like Maharashtra, Gujarat, Tamilnadu or Karnataka.

#### **What must Tata management have thought in selecting West Bengal in 2007?**

- The advantages are significant provided we can do something to overcome disadvantages.
- The infrastructure situation, although poor, is perhaps not worse than many other parts of the country and the new chief minister is committed to improve it.
- Politics - the main stumbling block is the negative power wielded by Communist party. They have power over unions and their nuisance value is very high. Given that it is a command and control organization, if we can get the senior leaders on our side then we should not expect resistance. The new chief minister (Mr. Bhattacharya) is pro reform and therefore let us get him firmly on our side.
- Politics – the Communist party is an outside partner (this means extending parliamentary support without joining cabinet) of pro-reform Congress party at the centre, so both the state government and the central government would be on our side.
- Politics - the main party opposed to the plant (Trinmool Congress) has been wiped out in recent elections and their influence has diminished.

Thus Tata did a proper stakeholder analysis and decided to secure support of the 2 most influential stakeholders, the chief minister of West Bengal and the Communist party in general. Communists party's supportive relationship with the Congress party at the centre made the case even stronger.

There were some issues in the way the Communist party obtained land from farmers to be sold to Tata for building the plant, however given communist influence in the state, this was not a big issue. After all in China, the determined communist government has managed to implement several such schemes provided they were convinced about it and successfully managed to overcome resistance.

With this level of methodical analysis what could possibly go wrong? Your biggest enemies have become your friends and other factors are all positive.

#### **The situation as of Aug 2008**

The farmers, whose land was allegedly taken with little payment, have managed to stage a huge agitation against the plant with help from Trinmool Congress. Its leader Ms. Banarjee, whose political future did not look great last year, has suddenly become centre of attention of industrialists and politicians alike. They are begging her to stop the agitation. Several other small organizations have joined the agitation. They have made it impossible for Tata employees

to even enter the plant. There is a huge security issue and Tatas are afraid that their employees may be subjected to physical violence. The plant has failed to start work. Many people have been killed and injured over last few weeks.

Tata chairman Mr Ratan Tata recently threatened to move out of West Bengal. The Communist party government is pulling all stops to save the plant and start production, however so far they are not getting anywhere. Maybe the perception that once they have taken a decision they can steamroll it was misplaced. Maybe Tata overestimated their power.

Meanwhile, the Congress government at the Centre has also fallen out with Communists over a totally unrelated matter (nuclear deal). As a result the W. Bengal state government has lost support of Central Government and the Centre has refused to intervene.

Other industrialists and the whole nation, especially business world is watching the situation. Some feel that Tata moving out of W. Bengal because of this would signal serious setback to progress of that state. For Tata the decision to move out means waste of investment worth 1500 crore (15 bn) Indian Rupees.

### **Factory flow' helps surgery productivity**

*Suggested question....*

1. *What do you think are the advantages and disadvantages of this arrangement when compared with the conventional layout of one surgeon remaining in one operating theatre?*

**What do you think are the advantages and disadvantages of this arrangement when compared with the conventional layout of one surgeon remaining in one operating theatre?**

The first point to make here is that, essentially, the layout has not changed as such. Both a conventional operating theatre and the arrangement described in the short case are 'fixed position' layouts. What has changed is that two patients are moved in and out of their operating theatres (the fixed positions) in order for preparation work that does not involve the surgeon to be carried out whilst the surgeon is operating on the other patient. This has the advantage of utilizing what presumably is the scarce resource (the surgeon) even though two operating theatres are now needed. To some extent it is moving towards the principles of flow processes because, although the patient does not move as such, they do move relative to the surgeon.

### **Chocolate and customers flow through Cadbury's**

*Suggested question.....*

1. *Both customers and chocolate in the Cadbury's operations do seem to conform to a product-type layout. Does this mean that both operations have the same objectives?*

**Both customers and chocolate in the Cadbury's operations do seem to conform to a product-type layout. Does this mean that both operations have the same objectives?**

Both chocolate and customers, in their respective operations, flow in a continuous manner around a set series of stages. All the chocolate follows the same path and, in Cadbury World, all

the customers take the same sequence of activities. Also in some ways the objectives are similar. We can strain the flow of chocolate to make sure that quality standards are conformed to and to reduce costs. Similarly, in Cadbury World we route customers through the same sequence of experiences to ensure the quality of the experience. To some extent also we are reducing the cost of processing the customers. Allowing customers to wander freely around the exhibits would limit what we could do at each exhibit. It would also mean putting more effort into guiding customers around the experience. Moving customers around Cadbury World in a standardised way helps us control the process.

## 6.4 Further example

### Weldon Hand Tools

Weldon Hand Tools, one of the most successful of the European hand tool manufacturers, decided to move into the 'woodworking' tools market. Previously its products had been confined to car maintenance, home decorating and general hand tools. One of the first products which it decided to manufacture was a general-purpose 'smoothing plane', a tool which smoothes and shapes wood. Its product designers devised a suitable design and the company's work measurement engineers estimated the time it would take in standard minutes (the time to perform the task plus allowances for rest etc.) to perform each element in the assembly process. The marketing department also estimated the likely demand (for the whole European market) for the new product. Its sales forecast is shown in the table below.

**Table Sales forecast for smoothing plane**

<b>Time period</b>	<b>Volume</b>
<b>Year 1</b>	
1st quarter	98 000 units
2nd quarter	140 000 units
3rd quarter	140 000 units
4th quarter	170 000 units
<b>Year 2</b>	
1st quarter	140 000 units

2nd quarter	170 000 units
3rd quarter	200 000 units
4th quarter	230 000 units

The marketing department was not totally confident of its forecast, however. *'A substantial proportion of demand is likely to be export sales, which we find difficult to predict. But whatever demand does turn out to be, we will have to react quickly to meet it. The more we enter these parts of the market, the more we are into impulse buying and the more sales we lose if we don't supply.'*

This plane was likely to be the first of several similar planes. A further model had already been approved for launch about one year after this, and two or three further models were in the planning stage. All the planes were similar, merely varying in length and width.

### **Designing the manufacturing operation**

It has been decided to assemble all planes at one of the company's smaller factory sites where a whole workshop is unused. Within the workshop there is plenty of room for expansion if demand proves higher than forecast. All machining and finishing of parts would be performed at the main factory and the parts shipped to the smaller site where they would be assembled at the available workshop. The table below gives the 'standard time' for each element of the assembly task. Some of the tasks are described as 'press' operations. These use a simple mechanical press that applies sufficient force for simple bending, riveting or force-fitting operations. This type of press is not an expensive or sophisticated piece of technology.

#### **Standard times for each element of assembly task in standard minutes (SM)**

<b>Element</b>	<b>Time in standard minutes (SM)</b>
<b>Press operations</b>	



Assemble poke subassembly	<b>0.12</b>
Fit poke subassembly to frog	<b>0.10</b>
Rivet adjusting lever to frog	<b>0.15</b>
Press adjusting nut screw to frog	<b>0.08</b>
<b>TOTAL PRESS OPERATIONS</b>	<b>0.45</b>
<b>Bench operations</b>	
Fit adjusting nut to frog	<b>0.15</b>
Fit frog screw to frog	<b>0.05</b>
Fit knob to base	<b>0.15</b>
Fit handle to base	<b>0.17</b>
Fit frog subassembly to base	<b>0.15</b>
Assemble blade subassembly	<b>0.08</b>
Assemble blade subassembly, clamp and label to base and adjust	<b>0.20</b>
Make up box and wrap plane, pack and stock	<b>0.20</b>
<b>TOTAL ASSEMBLY AND PACK TIME</b>	<b>1.60</b>

### **Costs and pricing**

The standard costing system at the company involves adding a 150 per cent overhead charge to the direct labour cost of manufacturing the product, and the product would retail for the

equivalent of around €35 in Europe where most retailers will sell this type of product for about 70–120 per cent more than they buy it from the manufacturer.

### **Questions**

- 1 How many staff should the company employ?
- 2 What type of facilities and technology will the company need to buy in order to assemble this product?
- 3 Design a layout for the assembly operation (to include the fly press work) including the tasks to be performed at each part of the system.
- 4 How would the layout need to be adjusted as demand for this and similar products builds up?

### **Weldon Hand Tools – Teaching note**

This case deals with the design of a manufacturing process to produce a relatively simple hand tool. Details of the product, together with times for each element which constitutes the assembly task, and sales forecasts for the product are all given in the case exercise. The product itself is a new design which is intended to sell at the lower end of the market in relatively high volume.

The case exercise makes an excellent 'hands-on' experience for students. It has been designed around a product which is readily available in most do-it-yourself stores. Each syndicate group of students can be given a product (we have found the Stanley Handyman plane both economical and useful!) together with a screwdriver. They usually find the product very easy to disassemble and can go through the various elements of the assembly task outlined in the case themselves when reassembling the product. It is usually unnecessary to point out to them that they are taking considerably longer than the 1.6 standard minutes specified in the case.

Although in any class different groups of students will come up with different process designs, there is usually a tendency to go for what Slack *et al.* call 'long-thin' systems. That is relatively long assembly-line type systems. They do this in the mistaken belief that any efficiency gains which derive from this process are in line with the company's performance objectives. In fact after discussing with students the relative merits of long-thin and short-fat systems it is useful to examine the economics of a product such as this, as outlined in the teaching notes. Students are sometimes surprised to find that saving small amounts of labour cost is relatively unimportant compared to keeping down inventory and maintaining flexibility.

## Some notes on the Weldon Hand Tools case exercise

### 1. How many people are needed to assemble the product?

Assume (for simplicity) that staff work 35 hours per week for 48 weeks per year.

- In the first quarter (12 weeks) the forecast requires 98,000 products to be assembled.
- The time available =  $12 \times 35 \times 60$  minutes  
= 25,200 minutes
- So a product should emerge from the assembly operation every  
$$\frac{25,200}{98,000}$$
$$= 0.257 \text{ minutes}$$
- The figure is called the **cycle time** of the operation and is an important figure in all process design activities.
- The total 'work content' (amount of work) of the assembly operation is 1.6 standard minutes (see earlier for the idea of a 'standard minute').
- The theoretical number of people required to assemble products at a rate of one every 0.257 minutes is therefore:
- $\frac{1.6}{0.257} = 6.226$  people
- Note that this figure might have to be modified either because of the convenience of assigning a fixed (whole) number of people to the task (a 'fraction' of a person could be arranged through part-time working), or because of the way the job is designed.
- The number of people required at the end of the two-year forecast period can be calculated in a similar manner.
- Cycle time =  $25,200/230,000$   
= 0.11 minutes  
$$\text{Number of people required} = 1.6/0.11$$
$$= 14.55 \text{ people}$$
- The forecast sales per quarter do not increase smoothly from 98,000 to 230,000; there is clear evidence of seasonality contained within the increasing sales. This poses a problem for any job design for the assembly operation. The design must be capable of accommodating increasing output requirements, with possible occasional short-term reductions in output.

### 2. Designing the production system.

- The design decision here is largely concerned with the extent of job specialisation (or put another way, the extent of the division of labour).
- There are a large number of ways of allocating all the elements in the assembly task to assembly staff. Let us examine just two extremes, one which uses a high degree of specialisation, one which goes as far as possible to minimise specialisation.

*Option A - high specialisation - the 'long-thin' design*

Numbering the 12 elements in the total assembly task from 1 (assemble poke S/A) to 12 (make up box, wrap plane, pack and stock).

Assembler 1 performs elements 1 and 2, total time = 0.22 SM

Assembler 2 performs elements 3 and 4, total time = 0.23 SM

Assembler 3 performs elements 5 and 6, total time = 0.20 SM

Assembler 4 performs element 7, total time = 0.15 SM

Assembler 5 performs element 8, total time = 0.17 SM

Assembler 6 performs elements 9 and 10, total time = 0.23 SM

Assembler 7 performs element 11, total time = 0.20 SM

Assembler 8 performs element 12, total time = 0.20 SM

Note that because of the difficulty in allocating elements equally between all assemblers, eight people are needed to meet the required cycle time (even then we have not quite made the necessary cycle times although we are probably close enough to make up any shortfall through a little overtime).

*Option B - no specialisation - the 'short-fat' design*

The design would merely require all assemblers to perform all the elements (1 to 12) needed to make and pack a complete product. Nominally at least, only seven assemblers would be needed because no inefficiencies are introduced through uneven allocation of work elements.

The arguments in favour of option A are:

- Faster learning of the tasks (although these assembly tasks are unlikely to take much learning as such).
- Parts of the task might be more easily automated (e.g. the press elements).
- Low levels of non-productive work will almost certainly mean that actual work times will be less than the standard minute values indicated.

- Equipment does not have to be supplied to every assembler (e.g. only two people need fly presses).
- Parts need only be moved to one point of the system (where they are being assembled).

The arguments against option A are:

- It is very monotonous.
- Losses due to uneven allocation of tasks are high.
- The arrangement is not robust in so much as one person stopping work will eventually stop all output.
- It is volume inflexible in so much as it is difficult to add extra assemblers to the arrangement.

The arguments in favour of option B are:

- Allocation losses are reduced to zero.
- The arrangement is robust, one person stopping will not affect the other assemblers.
- It is flexible in so much as extra people can easily be added to the arrangement (each making a different type of product if this becomes important).

The disadvantages of option B are:

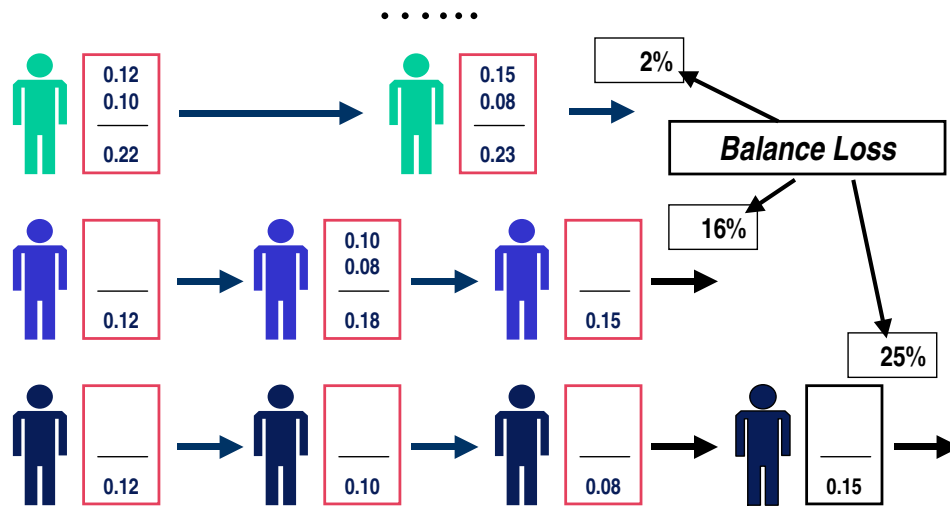
- Non-productive work may mean that the actual work times are longer than the 'standard minute' values.
- Each assembler will need every piece of equipment, e.g. seven fly presses.
- The logistics of getting all parts of the product to all individual assemblers may be complex.

#### **4. Changing the process as volumes change.**

The flexibility arguments above are key to understanding how job designs may have to change as volumes increase. The highly divided (specialised) arrangements are particularly difficult to rearrange so as to increase the capacity of an operation. There are two reasons for this. First, the introduction of each new person to the system will require the allocation of tasks to people to be changed, which itself may disrupt its smooth running. Second, as each new person is added to the production 'line', the losses associated with unequal allocation of work tend to increase.

To illustrate this last point, take just the first four elements of the Weldon Hand Tools assembly tasks, the press operations. The figure shows how the elements will need to be allocated to each assembler as the number of people allocated to the work is increased.

# Calculating balancing loss



The simple efficiency of job design can be measured by what is termed the 'balancing loss' of the arrangement. Put simply, it is the percentage of labour time invested in producing each product which is wasted because of unequal allocation of work.

With one person performing all the work, no time is wasted and the cycle time of the system is 0.45 minutes.

With two people sharing the tasks allocated as shown, the slowest person (who has the collection of elements with the largest total time) will determine the output (and hence cycle time) of the whole system, in this case 0.23 minutes. The total 'investment of labour' is 2 x cycle time, i.e. 2 x 0.23, of which only 0.01 (the time the faster person has to wait each cycle) is wasted. So the balancing loss = 2.17%.

With three people sharing the work as shown, the balancing loss increases to 16.7%.

With four people sharing the work as shown, the balancing loss increases further to 23.3%.

The only way of introducing a fifth person is to allocate two people to the largest of the four elements (effectively reducing the time taken to carry out that element to half its time, i.e. 0.075). The balancing loss increases further to 25%.

# Supply Network management

## 7.1 Introduction

The great advantage of teaching network management is that it has become a 'hot topic' in business generally. Most people will have heard of it even if they don't know exactly what it means. The positive side of this is that there is no problem in engaging students' attention, nor in finding examples of effective and ineffective supply chain management. The downside is that some of the issues are subtle, or strategic, or complex, or all three. Perhaps the most important objective of any session in supply chain planning and control is to convince students that supply chain management is not just about the movement of materials, or just a fancy term for logistics, or something that only applies to manufacturing, or something that is merely fashionable. Supply chain management is, in some ways, a fundamental change in how we see the role of operations. It really is about integrating a supplier's operation with a customer's operation. In fact it changes the nature of trading. In executive education we now spend much of our time teaching operations management ideas to sales and market people! Mainly because of a supply chain perspective, they are starting to understand that they cannot sell effectively to their business customers if they do not understand their customers operations. They therefore need the skills of operations management analysis to answer the fundamental question of how their operation can help their customer's operation to be more effective.

### ***Key teaching objectives***

- To demonstrate the ubiquity of supply chains and networks in business.
- To demonstrate how effective supply chain management has a major impact on the profitability of all businesses.
- To clarify the sometimes mystifying collection of terms contained within supply chain management, such as logistics, materials management, and so on.
- To establish the idea of different types of relationship which can exist between a pair of operations within a supply chain.
- To demonstrate the natural dynamic behaviour of supply chains over time.

## 7.2 Exercises/discussion points

There are many cases and exercises which one could use to introduce operations management. You might like to try some of these ideas, all of which we have used.

- **Teaching tip** - We have found that one of the most important points to come out of this chapter is an understanding of the whole concept of a supply network. Because of that we tend to spend more time on this issue than the others. One method of achieving this is to lead a discussion on the supply network for a familiar operation such as a restaurant. Suppliers can be traced back to food items, consumables such as napkins etc. Each of these can then be traced back to the suppliers' suppliers, back to the farm or paper factory etc. Similarly, moving downstream in the supply network, one can work to the consumer directly, or assuming that the restaurant supplies events such as dances and weddings, to the wedding organizer and then to the ultimate consumer.
- **Teaching tip** – The increasing importance of internet based trading (B2C) provides a good discussion point to demonstrate the importance of supply chain management in order fulfillment. Get students to look at examples of web sites (Tesco, Amazon, etc.) and then discuss the implications of this way of retailing on the whole supply chain.
- **Teaching tip** – An old, but useful example which we use to point out some of the issues in supply chain management is that of Benetton. There is a Case exercise included in this Instructors Manual, but there is also a Harvard case which is good, but now somewhat dated. There is also an accompanying video from the Case Clearing House which is likewise dated. However, parts of the video can be used in class to illustrate some aspects of the Benetton supply chain. Similarly, you can use the case as background material for yourself and explain the way the Benetton supply chain operates. The important point to stress is how the three stages in the supply chain fit well together. The individual retail stores are relatively efficient little units which carry limited stock and therefore rely on fast and dependable delivery to avoid stock-outs. This means the distribution system has to be fast and dependable, which in turn means the manufacturing and supply system has to be itself fast and flexible. This flexibility is given partly by the 'dyeing in grey' process used in the factory. The lesson being not that Benetton's supply chain is the single 'best' way to run any supply chain, but rather that it fits together. Increasingly the opportunities in supply chain management lie at the boundaries between operations.



- **Exercise** – An even better ‘Harvard style’ case (available from the Case Clearing House) is that of Zara. It is excellent at demonstrating many issues, operational and strategic, related to supply chain management. However remember that the ‘Fast fashion’ case at the end of this chapter covers part of the Zara story.
- **Exercise** – The role of the internet in all supply chain management, but particularly the purchasing activity, is a useful and interesting topic to investigate. Find a supplier interface by searching the websites of retail companies, choose a supplier interface, and ask the class (in groups) to draw up a list of advantages and disadvantages (from both the supplier and the customer perspective) of such mechanisms. The Tesco Information Exchange is one such interface. It is also a useful example to encourage debate.
- **Exercise** – The increasing importance of customer oriented internet based trading (B2C) provides a good discussion point to demonstrate the importance of supply chain management in order fulfilment. Get students to look at examples of web sites (Amazon, etc.) and then discuss the implications of this way of retailing on the whole supply chain.
- **Exercise** – Ask the students to use the table in the chapter to work through the arithmetic of supply chain fluctuations. A blank table is included in the PowerPoint slides for this chapter. Put on the OHP and work through it with the students. By getting them to calculate exactly how much needs to be produced at each stage in the supply chain during each period, they can get the idea of the amplifications in activity levels. This is increasingly referred to as the ‘bull whip’ effect.
- **Exercise** – Supply chain dynamics also lends itself to simple gaming. Just separating out groups of students into teams, each of which is a stage in the supply chain, imposing rules around order lead-times and inventory levels, and then changing demand at the end of the supply chain can lead to a very vivid example of the bull whip effect. The well known ‘Beer game’ is an ideal example of this type of game. (Just Google ‘beer game’.)

### 7.3 Suggested questions and answers to ‘operations in practice’ and short cases

## **Dell: No operating model lasts forever**

### *Suggested questions*

1. *How did Dell gain advantage from its original operating model?*
2. *Why did it have to change its original operating model?*

### **How did Dell gain advantage from its original operating model?**

The purpose of this example is to demonstrate that capabilities can be developed notwithstanding what may seem like unpromising circumstances. Dell were forced into adopting a different supply network configuration (bypassing conventional retailer channels) as the only way that they could compete with the low prices being offered by their more established rivals. However, rather than simply see this strategy as 'the only feasible option', they actively explored whether it would be possible to gain benefits from having no retail outlets. The lesson here is that there are often potential positives and negatives to every strategic option. Just because one is forced into an unorthodox competitive stance does not necessarily mean that the potential negatives of a strategy outweigh the more obvious positives. By being both energetic and creative, Dell managed to turn the disadvantages of having no retail outlets into a set of advantages built upon having direct contact with their consumers.

### **Why did it have to change its original operating model?**

Clearly its investment in a radically different supply chain configuration, although it gave it significant advantage in its early days, is now proving to be less than ideal for the new markets. When the radical supply chain model was set up, it was not at all obvious that the market would change in the way that it has with a far greater emphasis on design aesthetics and the merging of computing and entertainment products.

To some extent, the market has changed because of the action of competitors, most notably Apple who have educated consumers to the importance of good aesthetic design.

It is difficult to untangle two issues, both of which may explain Dell's dilemma. The first is the lack of fit between the company's supply chain configuration and the way markets are moving (as mentioned previously). The second is that Dell, unlike its early days, is a large and mature company which may have lost some of its cutting edge simple because of the growth that has come from its previous success.

But don't write off Dell yet. This example in the text should be taken as a warning of how 'core rigidities' go along with core competencies. It is certainly intended to be Dell's obituary.

Nevertheless, there are some points which are worth thinking about from Dell's dilemma.

## **Ford Motors' team value management**

Suggested questions....

1. How do you think Ford's suppliers will react to the TVM initiative?
2. As well as obvious savings in the cost of bought-in parts, do you think the TVM initiative could result in savings for Ford's sales dealerships and service centre?

### **How do you think Ford's suppliers will react to the TVM initiative?**

The traditional answer to this (and probably the right answer for the more conservative suppliers) would be that they would react badly. After all, the suppliers in the roof rack example cited in the box are no longer selling an expensive and presumably high-margin item but are now selling a cheaper and perhaps low value item to Ford. They are therefore certainly losing revenue, and probably profit also. In that way what is good news for Ford is less good news for its suppliers. Some companies however might see TVM as an opportunity. The companies who can pre-emptively suggest to Ford ways in which they could reduce their purchasing bills could increase their total share of Ford's business.

### **As well as obvious savings in the cost of bought-in parts, do you think the TVM initiative could result in savings for Ford's sales dealerships and service centre?**

Probably yes. The saving could come through reduced complexity through the parts commonality mentioned in the box. So, a service centre that previously stocked four or five different roof racks for different models of car, could now stock one common roof rack. This would reduce stock holding management costs and reduce the total amount of stock necessary to give the same service level.

## **Behind the brand names**

Suggested questions.....

1. *What are the dangers to companies like Dell and Sony in outsourcing their notebook manufacture?*
2. *How do you think the subcontracting companies will compete in the future?*

### **What are the dangers to companies like Dell and Sony in outsourcing their notebook manufacture?**

There are three main types of danger involved in outsourcing manufacturing in the way that Dell and Sony have in this case. The first is that part of the supply process is outside of the brand holder's direct control. So, for example, if the outsourcing company fail to ensure a robust process and supply is disrupted, it is the brand holder who will suffer (although compensation could be arranged). The second danger is that there may be a leakage of intellectual property. Subcontracting companies work for more than one brand holder. Indeed, that is their attraction, that they have experience in many different types of manufacturing tasks. There is always the danger that design information could inadvertently leak out to competitors. The third danger is that the brand holder may lose all the skills and competencies needed for a vital part of the process, namely manufacturing. If a very new design involves a very new technology that the outsourcing company could not master, the brand holder would have to 'start from scratch' in establishing competencies.

**How do you think the subcontracting companies will compete in the future?**

In fact it has already started! Increasingly, the subcontracting companies are developing design skills so that they are designing notebook computers then offering that design, together with manufacturing services, to their customers. The danger in this is that the brand holders are left with literally nothing but the brand.

**TDG serving the whole supply chain**

Suggested questions....

1. Why do you think that David Garman is moving TDG towards providing more sophisticated services to clients?
2. What are the risks in TDG's strategy

**Why do you think that David Garman is moving TDG towards providing more sophisticated services to clients?**

Simply because there is usually more profit to be made from providing complex services than simple ones. The problem with any company that produces simple products or services is that any other company can also do it. Therefore, because other companies have similar operations capabilities, prices will drop as each company tries to undercut the other. Conversely, products and services (such as sophisticated supply chain distribution services) are far more difficult to create. This means that only the companies with the required resources and experience can

provide such services. And if a company has few competitors it can more easily maintain higher prices and (hopefully) high margins. David Garman is moving towards providing more sophisticated services because it is more profitable for him to do so.

### **What are the risks in TDG's strategy**

The main problem with trying to provide sophisticated products and services is that they are (as we described above) difficult to create. Companies providing such products and services, therefore, are likely to be operating at the limit of their capability. Under these circumstances it is more likely that the company will make mistakes. The main danger with TDG's strategy is that it tries to offer sophisticated services before it has developed appropriate operations capabilities.

### **Seven-Eleven Japan's agile supply chain**

Suggested questions....

1. SEJ stores typically carry around 3,000 SKUs (stock keeping units, that is types of different product) compared with a large supermarket which may have over 10,000 SKUs. How do you think this affects their ability to manage their supply chain in an agile manner?
2. SEJ place a lot of emphasis on the use of their information system to achieve agility. How do you think the way in which an information system is used affects its value to a supply chain?

**SEJ stores typically carry around 3,000 SKUs (stock keeping units, that is types of different product) compared with a large supermarket which may have over 10,000 SKUs. How do you think this affects their ability to manage their supply chain in an agile manner?**

The lower level of SKUs reduces the complexity of the supply chain considerably. This is particularly evident when the supply chain has to respond to unexpected events (in other words when it has to have an agile supply chain). For example, if the company stored 100,000 SKUs it would need 100,000 safety stock and 100,000 different channels of communication to reorder and manage the flow of goods. It is obviously simpler to do this with 3,000 SKUs.

**SEJ place a lot of emphasis on the use of their information system to achieve agility. How do you think the way in which an information system is used affects its value to a supply chain?**

The key issue here is speed. And in supply chains the transparency of information assists fast response, both to customer requests and to unexpected events. SEJ's information systems are used both to monitor what is happening to sales and to the movement of goods through its supply chain. It is also used to modify plans based on what it is observing in its supply chain and make decisions without any unwarranted delay. Therefore, generally, to aid supply chain agility, information systems must be fast and transparent and be used to speed up decision reaction time.

## 7.4 Further examples

### Supplying fast fashion

Garment retailing has changed. No longer is there a standard look that all retailers adhere to for a whole season. Fashion is fast, complex and furious. Different trends overlap and fashion ideas that are not even on a store's radar screen can become 'must haves' within six months. Many retail businesses with their own brands such as H&M and Zara, sell up-to-the-minute fashionability and low prices, in stores that are clearly focused on one particular market. In the world of fast fashion catwalk designs speed their way into high street stores at prices anyone can afford. The quality of the garment means that it may only last one season, but fast fashion customers don't want yesterday's trends. As Newsweek puts it, *".....being a 'quicker picker-upper' is what made fashion retailers H&M and Zara successful. [They] thrive by practicing the new science of 'fast fashion'; compressing product development cycles as much as six times."* But the retail operations that customers see are only the end part of the supply chains that feeds them. And these have also changed.

At its simplest level, the fast fashion supply chain has four stages. First, the garments are designed, after which they are manufactured, they are then distributed to the retail outlets where they are displayed and sold in retail operations designed to reflect the businesses' brand values. In this short case we examine two fast fashion operations, Hennes and Mauritz (known as H&M) and Zara, together with United Colours of Benetton (UCB), a similar chain, but with a different market positioning.

**Benetton** - almost fifty years Luciano Benetton took the world of fashion by storm by selling the bright, casual sweaters designed by his sister across Europe (and later the rest of the world), promoted by controversial advertising. By 2005 the Benetton Group was present in 120 countries throughout the world. Selling casual garments, mainly under its United Colours of

Benetton (UCB) and its more fashion-orientated Sisley brands, it produces 110 million garments a year, over 90 per cent of them in Europe. Its retail network of over 5,000 stores produces revenue of around €2 billion. Benetton products are seen as less 'high fashion' but higher quality and durability, with higher prices, than H&M and Zara.

**H&M** - established in Sweden in 1947, they now sell clothes and cosmetics in over 1000 stores in 20 countries around the world. The business concept is 'fashion and quality at the best price'. With more than 40,000 employees, and revenues of around SEK 60,000 million, its biggest market is Germany, followed by Sweden and the UK. H&M are seen by many as the originator of the fast fashion concept. Certainly they have years of experience at driving down the price of up-to-the-minute fashions. *"We ensure the best price," they say, "by having few middlemen, buying large volumes, having extensive experience of the clothing industry, having a great knowledge of which goods should be bought from which markets, having efficient distribution systems, and being cost-conscious at every stage."*

**Zara** – the first store opened almost by accident in 1975 when Amancio Ortega Gaona, a women's pajama manufacturer, was left with a large cancelled order. The shop he opened was intended only as an outlet for cancelled orders. Now, Inditex, the holding group that includes the Zara brand, has over 1,300 stores in 39 countries with sales of over €3 billion. The Zara brand accounts for over 75 per cent of the group's total retail sales, and is still based in North West Spain. By 2003 it had become the world's fastest growing volume garment retailer. The Inditex group also has several other branded chains including Pull and Bear, and Massimo Dutti. In total it employs almost 40,000 people in a business that is known for a high degree of vertical integration compared with most fast fashion companies. The company believes that it is their integration along the supply chain that allows them to respond to customer demand fast and flexibly while keeping stock to a minimum.

### **Design**

All three businesses emphasize the importance of design in this market. Although not *haute couture*, capturing design trends is vital to success. Even the boundary between high and fast fashion is starting to blur. In 2004 H&M recruited high fashion designer Karl Lagerfeld, previous noted for his work with more exclusive brands. For H&M his designs were priced for value rather than exclusivity, *"Why do I work for H&M? Because I believe in inexpensive clothes, not 'cheap' clothes,"* said Lagerfeld. Yet most of H&M's products come from over a hundred designers in Stockholm who work with a team of 50 pattern designers, around 100 buyers and a number of budget controllers. The department's task is to find the optimum balance between the three components comprising H&M's business concept - fashion, price and quality. Buying volumes and delivery dates are then decided.

Zara's design functions are organized in a different way to most similar companies. Conventionally, the design input comes from three *separate* functions: the designers themselves, market specialists, and buyers who place orders on to suppliers. At Zara the design stage is split into three product areas: women's, men's and children's garments. In each area, designers, market specialists and buyers are co-located in design halls that also contain small workshops for trying out prototype designs. The market specialists in all three design halls are in regular contact with Zara retail stores, discussing customer reaction to new designs. In this way, the retail stores are not the end of the whole supply chain but the beginning of the design stage of the chain. Zara's around 300 designers, whose average age is 26, produce approximately 40,000 items per year of which about 10,000 go into production.

Benetton also has around 300 designers, who not only design for all their brands, but also are engaged in researching new materials and clothing concepts. Since 2000 the company has moved to standardize their range globally. At one time more than 20 per cent of its ranges were customized to the specific needs of each country, now only between 5 and 10 per cent of garments are customized. This reduced the number of individual designs offered globally by over 30 per cent, strengthening the global brand image and reducing production costs.

Both H&M and Zara have moved away from the traditional industry practice of offering two 'collections' a year, for Spring/Summer and Autumn/Winter. Their 'seasonless cycle' involves the continual introduction of new products on a rolling basis throughout the year. This allows designers to learn from customers' reactions to their new products and incorporate them quickly into more new products. The most extreme version of this idea is practiced by Zara. A garment will be designed; a batch manufactured and 'pulsed' through the supply chain. Often the design never repeated, it may be modified and another batch produced, but there are no 'continuing' designs as such. Even Benetton, have increased the proportion of what they call 'flash' collections, small collections that are put into its stores during the season.

### **Manufacturing**

At one time Benetton focused its production on its Italian plants. Then it significantly increased its production outside Italy to take advantage of lower labour costs. Non-Italian operations include factories in North Africa, Eastern Europe, and Asia. Yet each location operates in a very similar manner. A central, Benetton owned, operation performs some manufacturing operations (especially those requiring expensive technology) and coordinates the more labour intensive production activities that are performed by a network of smaller contractors (often owned and managed by ex-Benetton employees). These contractors may in turn sub-contract some of their activities. The company's central facility in Italy allocates production to each of the non-Italian



networks, deciding what and how much each is to produce. There is some specialization, for example, jackets are made in Eastern Europe while T-shirts are made in Spain. Benetton also has a controlling share in its main supplier of raw materials, to ensure fast supply to its factories. Benetton are also known for the practice of dying garments after assembly rather than using dyed thread or fabric. This postpones decisions about colours until late in the supply process so that there is a greater chance of producing what is needed by the market.

H&M does not have any factories of its own, but instead works with around 750 suppliers. Around half of production takes place in Europe and the rest mainly in Asia. It has 21 production offices around the world that between them are responsible for coordinating the suppliers who produce over half a billion items a year for H&M. The relationship between production offices and suppliers is vital, because it allows fabrics to be bought in early. The actual dyeing and cutting of the garments can then be decided at a later stage in the production. The later an order can be placed on suppliers, the less the risk of buying the wrong thing. Average supply lead times vary from three weeks up to six months, depending on the nature of the goods. However, *"The most important thing," they say, "is to find the optimal time to order each item. Short lead times are not always best. Some high-volume fashion basics, it is to our advantage to place orders far in advance. Trendier garments require considerably shorter lead times."*

Zara's lead times are said to be the fastest in the industry, with a 'catwalk to rack' time as little as 15 days. According to one analyst this is because they *"owned most of the manufacturing capability used to make their products, which they use as a means of exciting and stimulating customer demand."* About half of Zara's products are produced in its network of 20 Spanish factories, which, like at Benetton, tended to concentrate on the more capital intensive operations such as cutting and dying. Sub-contractors are used for most labour intensive operations like sewing. Zara buy around 40 per cent of their fabric from its own wholly-owned subsidiary, most of which is in undyed form for dying after assembly. Most Zara factories and their sub-contractors work on a single shift system to retain some volume flexibility.

### **Distribution**

Both Benetton and Zara have invested in highly automated warehouses, close to their main production centres that store, pack and assemble individual orders for their retail networks. These automated warehouses represent a major investment for both companies. In 2001, Zara caused some press comment by announcing that it would open a second automated warehouse even though, by its own calculations, it was only using about half its existing warehouse capacity. More recently, Benetton caused some controversy by announcing that it was exploring the use of RFID tags to track its garments.

At H&M, while the stock management is primarily handled internally, physical distribution is subcontracted. A large part of the flow of goods is routed from production site to the retail country via H&M's transit terminal in Hamburg. Upon arrival the goods are inspected and allocated to the stores or to the centralized store stock room. The centralized store stock room, within H&M referred to as "Call-Off warehouse" replenishes stores on item level according to what is selling.

### **Retail**

All H&M stores (average size, 1,300 square metres) are owned and solely run by H&M. The aim is to *'create a comfortable and inspiring atmosphere in the store that makes it simple for customers to find what they want and to feel at home'*. This is similar to Zara stores, although they tend to be smaller (average size, 800 square metres). Perhaps the most remarkable characteristic of Zara stores is that garments rarely stay in the store for longer than 2 weeks. Because product designs are often not repeated and produced in relatively small batches, the range of garments displayed in the store can change radically every two or three week. This encourages customers both to avoid delaying a purchase and to revisit the store frequently.

Since 200 Benetton have been reshaping its retail operations. At one time the vast majority of Benetton retail outlets were small shops run by third parties. Now these small stores have been joined by several, Benetton owned and operated, larger stores (1,500 to 3,000 square metres). These mega-stores can display the whole range of Benetton products and reinforce the Benetton shopping experience.

### **Question**

Compare and contrast the approaches taken by H&M, Benetton and Zara to managing their supply chain

## **Supplying fast fashion Teaching note**

### **Case synopsis**

This case uses publicly quoted information (usually from the companies' own websites) to compare three well-known fashion retailers, all based in Europe. These three retailers are Benetton, based in Northern Italy, H&M, based in Sweden, and Zara, based in Spain. The three companies are described in the context of what has come to be known as 'fast fashion'. The fast fashion phenomenon is relatively new and is based on the idea that consumers increasingly require high fashion clothes at a relatively cheap price, and are indifferent to how long the

clothes may last in use because 'who wants to be wearing yesterday's trends?' A general background to each company is provided and then the operations practice of each company is examined under the four stages of garment supply chains, namely design, manufacturing, distribution, and retail.

## **Using the case**

This case is relatively strategic the context of the chapter that supports it. Chapter 3 in the text examines what might be termed the more 'strategic' aspects of supply network design. Chapter 7 (this chapter) treats some of the more operational issues. Yet, the boundary between what is strategic and what is operational in supply network/chain management is somewhat arbitrary. And although this case does not examine the very operational issues of how each of these companies supply chains operates, it does provide a starting point for a debate on what, in practice, the operational issues would be. The virtue of the case is that all three companies are relatively well-known. How well-known they are to a post graduate class will depend on the make-up of the class. Although the stores do not deal exclusively in women's' garments, it is more likely that women will have heard of the stores and be aware of the differences between them. Also, the older the class, the less likely they are to be interested in fashion. So, some explanation may be necessary. This is not difficult. Press adverts can be used, catalogue images can be shown, and so on. The one problem with using companies like these is that some class members may have their own individual views on the companies' products. (I hate the stuff Benetton sells, etc.) This can be destructive and inhibit discussion. It is important to be very clear with the class that their personal preferences should not cloud the issues involved here. The fact that all three companies have been (more or less) successful over a number of years is testament to the fact that somebody is buying their products.

## **Notes on questions**

In fact there is only one question attached to this case in the text. This does not mean that the class debrief of the case needs to be centred only around this one question. Nevertheless, given the nature of the information in the case, it does lend itself to a very broad 'compare and contrast' mode of analysis.

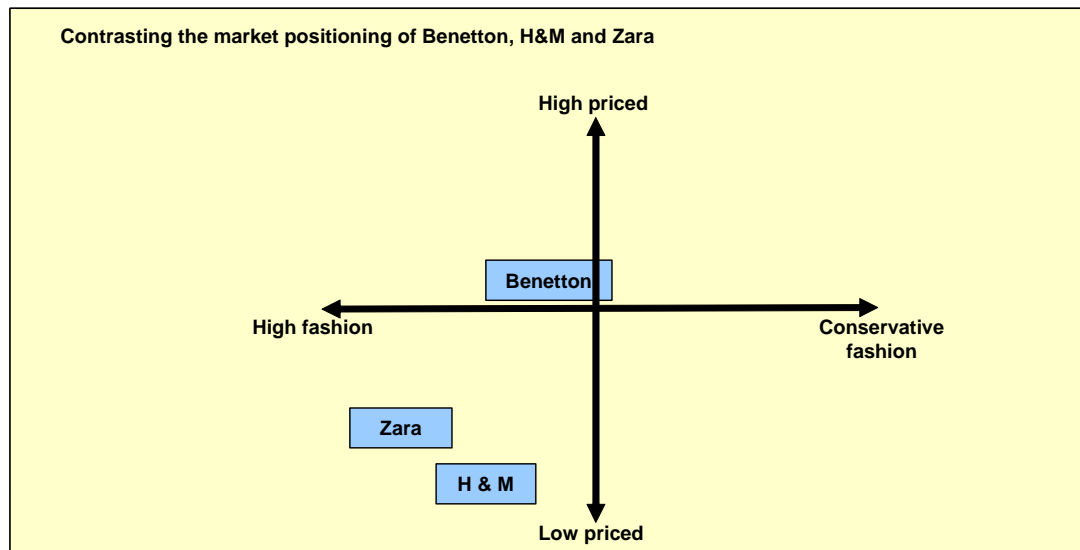
If required, the case debrief can be broken down into smaller segments such as the following.

- How would you class the three companies in terms of the markets they serve?

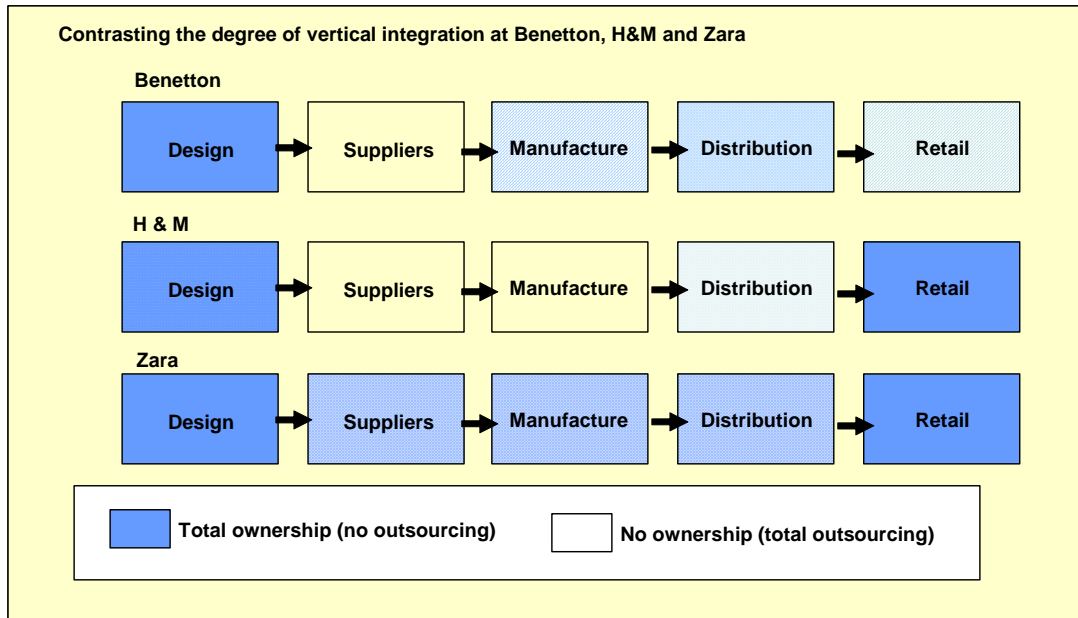
- How do they differ in terms of their approach to design stage of the supply chain?
- How do they differ in terms of the manufacturing stage of the supply chain?
- How do they differ in terms of the distribution stage of the supply chain?
- How do they differ in terms of the retail stage of the supply chain?
- How would you summarize the general differences between the companies in terms of their approach to supply chain management?

Here, we will address these questions in roughly this order.

The markets occupied by these companies (or rather, Brands) could be analysed in several ways. But this is not a Marketing case, and all that is necessary here is to establish (approximately) the similarities and differences between the three brands. A diagram similar to the one below is useful for doing this.



case is divided into two parts; the supply of parts and the manufacture of the garment. This is not strictly necessary, but can be used to prompt a debate about exactly what the company has chosen to own. There is, after all, a difference between how much of the finished garment to manufacture and assemble, and how many of the components that go into the finished product do they want to supply internally.



## Design

Notable here is that all three companies do the majority of their own design. In fact, Benetton and Zara do virtually all of their own design in-house, while H&M are using 'guest designers', but mainly to exploit the reputation of these designers.

It is worth debating with the students why, of all the stages in the supply chain, it is design that these companies are the most reluctant to outsource. Students may well conclude that, in an industry concerned with fashion, an aesthetic value, the design stage is the operation that contributes the most to the market image of the company. At this point try and broaden the debate from looking at the aesthetics of design towards thinking of design as one process in the total supply chain. Ask the class what they think are the main process objectives for the design part of the supply chain. Most will agree that speed is very important, as is quality (in terms of fitness for purpose). Similarly, where distinctive seasons are still used (more so at Benetton, less so at Zara) dependability, that is having designs finished in time for the clothes to be put through the supply chain and reach the stores in time for the season, is also relatively important. Flexibility may also be raised as an issue. In the discussion here, try and draw the distinction between flexibility and agility. The concept of agility (being flexible, fast, and responsive) is may be a better way of thinking about fast fashion. The issue of cost is worth discussing. Here we are not talking about the cost of the finished garment (this is important but part of quality as 'fit for purpose') but the cost of producing the designs. While this cannot be allowed to get out of

control, each company seems to understand the importance of not under resourcing the design process.

### **Suppliers and manufacturing**

Benetton do not own any of its suppliers. It does not make cloth or spin yarn. However, because it does manufacture some stages of the garment making process, it will have an interest in relationships with suppliers. As regards the manufacturing stage, Benetton has plants both in Italy and around the world, but relies significantly on a large number of 'contractors' who perform most of the manufacturing. The interesting point here is that these contractors are often owned and managed by ex-Benetton employees. This may be worth discussing in class, especially in terms of the advantages and disadvantages of this practice (close relationships and loyalty versus complacency and conflict of interest).

H&M do not own any part of the supply and manufacturing stages of the supply chain. This is quite a deliberate policy. Of the three companies, they are the only one to keep totally clear of these activities. It is well to try and have a discussion with the class about why this might be. Several suggestions could be made including,

- It means they do not require the capital to invest in expensive manufacturing plant.
- They are specialists in designing and selling rather than manufacturing, so it is best to stick to what you know best.
- There are plenty of companies around the world who can make garments, increasingly these are in relatively cheap labour cost economies. Managing these factors is a specialized task.
- Generally there is more margin in service activities than in manufacturing activities.

While all of these points are valid, it is worth facing the class with the question of why the other two companies (particularly Zara) have invested in these stages of the supply chain. Discussion here usually centres on the idea of control and speed of throughput.

Of the three, Zara is characterized by very significant investment in both these stages. Partly, this may be because unlike the other two companies, Zara started out as exclusively a manufacturing organization. Mainly though, it is because Zara believe that they acquire distinct capabilities by owning so much of these stages (and other stages) of the chain. Try and avoid debating this issue at this point with the class. Generally it is best left for the overview of the whole case.

## **Distribution**

Very few companies of this type still perform all their own distribution. All three have warehouse facilities. In particular, Zara have put significant investment into warehousing. Ask the class why warehousing is important to companies like this. The debate should focus around the concept of speed. Ask the question, *"What is a warehouse for?"* Answers usually start off by describing warehouses as places where inventory is stored. Ask whether this is what happens with Zara (as the company with the most investment in automated warehousing). The answer is that for fast fashion companies, increasingly a warehouse is not a storage place as such; it is rather a sorting operation, similar to a post office. Goods should not stay for long in the warehouse (if at all) rather, the warehouse is too split batches up and reassemble them for delivery to the retail stores. To that degree, it is an extension of the factory.

The other part of distribution is the physical logistics of moving the goods around the world. This is part of any company that is most likely to be outsourced. As far as one can gather, all three companies outsource a very significant part of this activity.

## **Retail**

Here we have a contrast between Benetton on one hand (who own very few of their own retail stores) and H&M and Zara on the other hand (who own them all, except for partnerships in countries where this is a legal necessity). Again, ask the class why this should be. Discussion may initially focus on the advantages of not owning your stores, but relying on franchising them instead. This is what Benetton does. The main advantage here is that the company can expand without investing too much of its own capital. So why have Zara and H&M chosen not to franchise at all? This where the discussion can be moved on to discuss the more general issues concerning the broad differences between the three companies.

## **Overview of the three companies**

The main point here is that, although all three companies are in (more or less) the same part of the market, they have chosen to organize themselves in some what different ways. One point here is that there is no obvious best answer in the design or management of supply chains. However, there are differences between the companies and these are reflected in the design chain choices they have made.

Benetton can be seen as primarily as a 'brand'. This is supported by the nature of its clothes (the United Colours of Benetton) which is why it retains control over the design process. But apart from that its main concern is to establish the brand in the market by building on its image (hence the concentration on advertising, not entirely successful in every market). But the focus is always on the brand and the image. It does not therefore need total control of the rest of the supply chain in order to achieve this. All it needs sufficient control through the factories that it does have and the stores and franchise agreements that it operates, to exert a guiding influence on the stores brand image.

H&M is again primarily a design-led company, but one that has chosen to manage its market growth by investing in retail. This may be partly because H&M generally sells at a lower price point than Benetton. One would assume therefore that its margins are less. Therefore, it may wish to retain the entire retail margin for itself rather than give some of it to franchise holders. To an even greater extent than Benetton, it does not invest in between the design and the retail stages of the supply chain. In this it is similar to many other companies operating in this part of the market, Gap for example.

Zara is the most interesting of three in many ways. It has a far higher degree of vertical integration and it also has the fastest throughput time from design to retail store. These two facts are not unrelated. Zara focuses on speed through control. It believes that controlling a large part of the supply chain is the only way to guarantee very fast supply chain throughput. Also, because Zara produces a huge number of new designs every year (it is more likely to modify a garment or design it afresh than it is to repeat an order) it places even more emphasis on the need to control the total throughput.

### **Northern Foods wins a slice of the in-flight meals business**

The companies that provide airline catering services are in a tough business. Meals must be of a quality that is appropriate for the class and type of flight, yet the Airlines who are their customers are always looking to keep costs as low as possible, menus must change frequently (3 monthly) and respond promptly to customer feedback. If this were not enough, forecasting passenger numbers is particularly difficult. Catering suppliers are advised of the likely numbers of passengers for each flight several days in advance, but the actual minimum number of passengers for each class is only fixed six hours before take-off (although numbers can still be increased after this, due to late sales). Also, flight arrivals are sometimes delayed, putting pressure on everyone to reduce the turnaround time, and upsetting work schedules. And even



when a flight lands on time no more than 40 minutes are allowed before the flight is ready for take-off again, so complete preparation and a well-ordered sequence of working is essential. It is a specialised business, and in order to maintain a fast, responsive and agile service, airline caterers have traditionally produced food on, or near, airport sites using their own chefs and staff to cook and tray-set meals. The catering companies' suppliers are also usually airline specialists who themselves are located near the caterers so that they can offer very short response times.

The companies that provide catering services may also provide related services. For example, LSG Sky Chefs (a subsidiary of Deutsche Lufthansa AG) is a provider of tailor-made in-flight services for all types of airlines around the world. Their main areas of service are Airline Catering, In-flight Equipment and Logistics and In-flight Management. They are also large, employing 30,000 people at 200 customer service centres in 49 countries. In 2007 they produced 418 million meals for more than 300 airlines, representing more than 30 percent of the global airline catering market.

But the airline sector has over recent years suffered a series of shocks starting with 9/11, oil price volatility, financial crises and world recession. This has meant that airlines are reviewing their catering supply solutions. In December 2008 Gate Gourmet, the world's largest independent provider of airline catering lost the contract to supply British Airways' short-haul flights out of Heathrow to new entrants into the airline catering market, a consortium of Northern Foods, a leading food producer, whose normal business is supplying retailers with own label and branded food, and DHL, a subsidiary of Deutsche Post and the market leading international express and logistics company. DHL is already a large supplier to "airside" caterers at Heathrow and already has its own premises at the airport. Northern Foods will make the food at its existing factories and deliver it to DHL, which will assemble onto airline catering trays and transfer them onto aircraft. The new contract is the first time that Northern Food, whose biggest customer is Marks and Spencer, the UK Retail chain, has developed new business outside its normal supermarket customer base. It said it was "delighted to have been chosen by BA based on the quality of our food".

Suggested questions....

1. Why would an airline use a catering services company rather than organise its own onboard services?
2. What are the main operations objectives that a catering services company must achieve in order to satisfy its customers?
3. Why is it important for airlines to reduce turn-around time when an aircraft lands?

4. Why is the Northern Foods – DHL consortium a threat to other, more traditional, catering services companies?

**Why would an airline use a catering services company rather than organise its own onboard services?**

Because it may not be a specialist. Certainly smaller airlines could not get the economies of scale which catering services companies can achieve. Secondly, as catering services companies attract most customers it develops a level of expertise in on-board catering which would be difficult to match. In fact the longer a catering services company is in the business the more it will learn and the bigger its operation will get (presumably), and therefore the greater its advantages will be.

**What are the main operations objectives that a catering services company must achieve in order to satisfy its customers?**

Quality, dependability and cost.

Quality because any customer dissatisfaction will reflect directly on the airline rather than on the catering services company. A customer who is upset because of the poor quality of a 10 euro meal could next time spend his or her 4000 euro fare with another airline.

Dependability because if a meal is not ready for loading onto the aircraft in time it will either be delayed (hugely expensive), or will have to take off without the meals on-board (hugely embarrassing).

Cost because unless catering services companies can offer the service cheaper than the airlines could do it themselves, they are unlikely to outsource the business.

**Why is it important for airlines to reduce turn-around time when an aircraft lands?**

Because it allows for better utilisation of the aircraft and aircraft are very expensive assets. For local flights this is especially important. A turn-around time of an hour is as long as many flight durations within Europe. This means that the aircraft is not in the air for over half its time.

**Why is the Northern Foods – DHL consortium a threat to other, more traditional, catering services companies?**

Because the economies of scale are even greater. Northern Foods produces foods for the general retail markets (supermarkets). The volumes involved are likely to be many times greater

than catering services companies. Also, although the traditional catering services companies are generally located close to airports and can therefore achieve dependable delivery, DHL also have considerable experience at reliable delivery.

### **Extracts from Levi Strauss' Global sourcing policy**

Our Global Sourcing and Operating Guidelines help us to select business partners who follow workplace standards and business practices that are consistent with our company's values. These requirements are applied to every contractor who manufactures or finishes products for Levi Strauss & Co. Trained inspectors closely audit and monitor compliance among approximately 600 cutting, sewing, and finishing contractors in more than 60 countries. .... The numerous countries where Levi Strauss & Co. has existing or future business interests present a variety of cultural, political, social and economic circumstances. .... The Country Assessment Guidelines help us assess any issue that might present concern in light of the ethical principles we have set for ourselves. Specifically, we assess .... the...Health and Safety Conditions Human Rights Environment, the Legal System and the Political, Economic and Social Environment would protect the company's commercial interests and brand/corporate image. The company's employment standards state that they will only do business with partners who adhere to the following guidelines:

**Child Labor:** Use of child labor is not permissible. Workers can be no less than 15 years of age and not younger than the compulsory age to be in school. We will not utilize partners who use child labor in any of their facilities.

**Prison Labor/Forced Labor:** We will not utilize prison or forced labor in contracting relationships in the manufacture and finishing of our products. We will not utilize or purchase materials from a business partner utilizing prison or forced labor.

**Disciplinary Practices:** We will not utilize business partners who use corporal punishment or other forms of mental or physical coercion.

**Working Hours:** While permitting flexibility in scheduling, we will identify local legal limits on work hours and seek business partners who do not exceed them except for appropriately compensated overtime. Employees should be allowed at least one day off in seven.

**Wages and Benefits:** We will only do business with partners who provide wages and benefits that comply with any applicable law and match the prevailing local manufacturing or finishing industry practices.

**Freedom of Association:** We respect workers' rights to form and join organizations of their choice and to bargain collectively. We expect our suppliers to respect the right to free association and the right to organize and bargain collectively without unlawful interference.

Discrimination: While we recognize and respect cultural differences, we believe that workers should be employed on the basis of their ability to do the job, rather than on the basis of personal characteristics or beliefs. We will favor business partners who share this value.

Health & Safety: We will only utilize business partners who provide workers with a safe and healthy work environment. Business partners who provide residential facilities for their workers must provide safe and healthy facilities.

## **Extracts from Levi Strauss' Global sourcing policy Teaching note**

Suggested questions....

1. What do you think motivates a company like Levi Strauss to draw up a policy of this type?
2. What other issues would you include in such a supplier selection policy?

What do you think motivates a company like Levi Strauss to draw up a policy of this type? There are almost always two motives for companies from developed countries to draw up this type of document. The first is straightforward ethics. Many organizations do take their responsibility seriously to improve working conditions in developing countries, even though there may be a price to pay in the sense that enforcing such working conditions may increase the cost of supplied products in the short-term. Nevertheless, it is the second motive that is often regarded as the more powerful. This is that companies risk seriously damaging their reputation if it is discovered that they are using a developing country's suppliers whose practices are not acceptable to consumers in developed countries. This 'reputational risk' issue has become particularly important as consumers have become more sensitized to these issues and the news media have realized the news value of such exposés.

### **What other issues would you include in such a supplier selection policy?**

The obvious omission in the extracts quoted in the short case concerns suppliers' suppliers. The emphasis in the document is on the direct suppliers to Levi Strauss. Yet there may be many contractors and subcontractors to these suppliers whose practices are not up to standard. Admittedly this is a particularly difficult area in which to enforce the principles set out in the document, but some would argue that it is worth making some attempt. The other issue that the document only hints at is that many practices that are frowned upon in developed countries are seen very differently in developing countries. The issue of child labour for example may be appalling in many consumers' eyes, but could provide vital economic benefits in some part of the world. This is not to say that Levi Strauss are wrong to insist on no child labour being used, it is simply to point out that many of these issues look different from different perspectives.



## CHAPTER 8

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# Capacity Management

## 8.1 Introduction

This topic is one of the easier topics in operations management to teach. First, it is an issue which quite clearly is important to all different types of operation. This means that it is relatively easy to find examples with which to stimulate the class. Second, it is not difficult to persuade the class that it is a very important issue. They have all had experience of queuing because capacity cannot meet demand at banks, restaurants, etc. They can also usually appreciate the problems of excess capacity where machines are lying idle and people underutilised. Third, there are a number of very clear approaches to managing capacity in the medium-term which have easily articulated advantages and disadvantages. Because of this, it is not difficult to promote debate. Fourth, the issue has an interesting ethical dimension in terms of whether the use of temporary labour and part-time contracts is ethically acceptable. All of which makes it a joy to teach!

### *Key teaching objectives*

- To convince students of the ubiquitous nature of medium-term capacity planning and control.
- To point out the importance of aggregating capacity and demand while at the same time illustrating the inaccuracies that brings into the process.
- To clearly identify the alternative approaches to capacity management together with their advantages and disadvantages.
- To try and give a sense of the dynamic nature of capacity planning and control.

## 8.2 Exercises/discussion points

There are many cases and exercises which one could use to introduce operations management. You might like to try some of these ideas, all of which we have used.

- **Teaching tip** – For classes where the students are (or have been) in employment, try starting a class by asking any student, 'What is your capacity?' First there will be discussion of what measures to use to best represent capacity. Then there will be discussion about the 'it

depends' issue. That is the assumptions regarding capacity (for how long do I have to maintain this capacity? What mix of products / services am I expected to produce? Do you expect me not to reduce the quality of service I give? And so on. By writing all these points on the board, one can often identify all the major problems of measuring capacity.

- **Teaching tip** - Employ the common approach of identifying three or four operations with which students will be familiar (fast food restaurants, libraries, book shops, etc.) and ask them to identify,
  - The nature of demand fluctuation and what influences it
  - The way in which they can measure their capacity
  - The alternative ways they could cope with fluctuating demand
- Then lead a discussion on the implications of the various ways of coping with fluctuating demand (cost implications, customer service implications, attitudes of staff, etc.).
- **Teaching tip** - Examples in the food industry are usually useful. This is because demand is often both seasonal and uncertain (sales of cottage cheese at supermarkets are very much dependent on the weather, sales of cottage cheese with pineapple chunks are far less weather dependent!). Also, the effective supply of some food stuffs is both seasonal and uncertain. To add to this many food products are perishable.
- **Teaching tip** - One can start off the discussion of the general issue of capacity planning and control by picking an example which is clearly highly seasonal. In Europe, Christmas products or Easter products are usually a good idea. For example, draw a (approximate) demand curve for Christmas crackers. Very few are sold in January, millions are sold just before Christmas. Ask the class how it would cope with such a demand fluctuation and categorise their suggestions under the headings of the three pure plans outlined in the chapter.
- **Teaching tip - The outlook matrix** – A useful discussion can be based on the 'outlook matrix'. One of the main influences on operations managers, when they are making period-by-period capacity decisions, is their confidence in future demand matching future capacity. If they are confident that, in the long term, demand is likely to exceed current capacity then, irrespective of the current level of demand, they will be more likely to be tolerant of policies which could lead to short-term over-capacity. Conversely, if long-term demand looks poor, it will be necessary to start implementing policies that will reduce long-term capacity. Overlying this are the needs of current demand. Even if long-term demand looks poor, it might be

necessary to increase capacity if there is a short-term requirement. The next figure shows an outlook matrix, and gives examples of the types of methods which might be adopted for different combinations of long-term and short-term outlook. Here outlook is defined as:

- Outlook =  $\frac{\text{forecast demand}}{\text{forecast capacity}}$
- Three broad states of outlook are identified for both the long and short term: 'poor' is when the ratio of forecast demand to forecast capacity is less than 1; 'normal' is when the ratio is approximately equal to 1; 'good' is when the ratio is greater than 1.

Three broad states of outlook are identified for both the long and short term: 'poor' is when the ratio of forecast demand to forecast capacity is less than 1; 'normal' is when the ratio is approximately equal to 1; 'good' is when the ratio is greater than 1.

**The dynamics of capacity planning are governed partly by the combination of long-term and short-term outlook**



		Short-term outlook		
		POOR Outlook < 1	NORMAL Outlook = 1	GOOD Outlook > 1
Long-term outlook	POOR Outlook < 1	Lay-off staff	Delay any action	Overtime Hire temporary staff
	NORMAL Outlook = 1	Short-time Idle time	Do nothing	Overtime Hire temporary staff
	GOOD Outlook > 1	Make for inventory Short-time	Hire and make for inventory Start to recruit	Hire staff

Outlook =  $\frac{\text{Forecast demand}}{\text{Forecast capacity}}$

- When both long-term outlook and short-term outlook are poor, there is relatively little choice but to reduce the capacity of the operation; capacity is not needed now, nor is it likely to be needed in the future. Staff lay-offs might be the only method of achieving this. When short-term outlook is normal, but long-term outlook is poor, current capacity needs to be maintained, though certainly not increased. Under these circumstances the operation is most likely to delay any decisions. Certainly it would not commit investments in capacity which is unlikely to be needed in the future. When short-term outlook is good in spite of long-term outlook being poor, the operation faces a dilemma. It does not want to make any permanent commitments to increase capacity because the extra capacity will not be needed in the future. However, it does need to meet current levels of demand. Under these circumstances the use of overtime or the recruitment of temporary staff might be the least permanent methods of achieving short-term capacity requirements.
- When long-term outlook is normal and short-term outlook is poor, capacity needs to be temporarily reduced but not in such a way as to compromise longer-term requirements. The operation here is likely to tolerate a certain amount of unproductive or idle time, or might perhaps reduce the working hours of its staff temporarily. When both long-term outlook and short-term outlook are normal, no action is required. However, when short-term outlook is good, capacity will need to be increased but not in any permanent manner. Again, overtime and the use of temporary staff are likely to be appropriate methods.

- When the long-term outlook is good, there will be a requirement to build up capacity in some way, irrespective of short-term circumstances. So, when the short-term outlook is poor, the operation will not want to do anything which compromises long-term capacity. It may even, if possible, use any short-term surplus capacity to build up inventory. It is also likely to do this when long-term outlook is good and the short-term outlook is normal. Here, though, it will need to start recruiting extra staff or working overtime if it wants to make products for inventory. Finally, when both long-term outlook and short-term outlook are good, capacity will need to be increased relatively quickly and probably in a permanent manner through hiring extra staff.
- **Exercise** – Try instructing groups to select an industry (preferably one where at least one of the group has some experience). Ask each group to explore how companies in that industry learn how to cope with seasonal fluctuations, and how might they adopt other approaches.
- Alternatively suggest a company. Again food is good. We often use Nestlé, the Swiss-based multinational, the largest food company in the world. Either the supply of materials is seasonal (frozen vegetables) or demand is seasonal (ice-cream), or both (dried milk). The manufacturer of chocolate products is typical. Demand is driven partly by the weather – chocolate is less popular in summer – and partly by cultural factors – chocolate is a popular gift at Christmas and Easter in many countries. Nestlé plants use a combination of strategies to cope with these demand fluctuations. Some products can be stored in anticipation of seasonal peaks. However, there is a ‘shelf-life’ limit on storage time if Nestlé’s high-quality standards are to be maintained. Off-peak sales volumes can also be influenced through the use of ‘special offers’ and product promotions. Within Nestlé’s plant themselves, output rates can be fluctuated, although different ways of doing this may be appropriate at different stages in the process. The manufacture of the chocolate itself is constrained by the capacity limits of the process technology, whereas in the packing of assortments, for example (see picture), extra staff can be hired at peak times. All this makes for a sensitive decision-making environment. If Nestlé managers get it wrong, either we run out of our favourite products or the company is left with surplus stock.
- Questions that students could be asked include these two.
- **What are the main ‘trade-offs’ which Nestlé managers have to get right in coping with the seasonality of their chocolate products?**
- There are a number of trade-offs, including the following.
- Adjustment costs versus inventory costs – changing the level of output continually will incur costs (as described in the chapter) but will minimise the amount of inventory stocked.

Alternatively, level production volumes reduce operations costs but incur inventory related costs.

- Quality of product versus inventory costs – a further consequence of keeping high inventories is that the longer the products are kept in storage, the shorter the shelf life and the more likely the product is to deteriorate, affecting its quality. However, the more risks the company is prepared to take with quality (in Nestlé's case not at all), the more it can reduce its inventory costs.
- Special offers versus manufacturing costs – adjusting demand by using special offers incurs costs of its own. Extra packaging costs, the cost of introducing new products and so on, are all part of the costs associated with special offers. However, if these are used during low demand periods, manufacturing costs could be kept lower because output would be constant.
- **What do you think are the differences between managing seasonality for the popular snack bar type products (known as 'count lines') and up-market chocolate assortments?**
- The main difference is that the degree of seasonality could be far higher. The standard products (count lines) will be seasonal of course, especially in some parts of the world. For example, in very hot countries sales of chocolate reduce dramatically during the summer months (it melts). However, sales of chocolate assortments peak at the times of the year when they are bought as gifts (Christmas, Easter, etc.). This fluctuation is often very much higher than for the standard products. The other difference is that (as the pictures illustrate) the production of assortments is far more labour intensive because it is essentially an 'assembled' product. Also quality has to be higher. Standard products on the other hand are made totally automatically (because of their far higher volume and simpler design). The potential for flexing capacity is greater with more labour intensive processes.

### **Exercise - The Perfect Pizzas Division of KT Foods**

KT Foods is a multi-national American based food and beverage company. In November 2011 Mr Frank C Matischek was promoted to Plant Manager of the Company's European Pizza Division, located outside Lyon. An American, he had been given the job for two reasons. First, the parent company in the USA were concerned at the poor record of the Lyon plant in terms of meeting production targets which, it was felt, he could improve. Second, the whole of the European operation

was about to reorganise. The reorganisation would take away each division's sales and marketing function and centralise them into a Marketing Division. It was hoped that this new division would rationalise distribution, reduce overall stock investment, and improve the quality of sales forecasts. Each manufacturing division would then sell to the sales division at cost, plus a small percentage. The Marketing Division would take responsibility for all finished goods stocks. This form of organisation had been used by the US company for some years and they particularly wanted an American Plant Manager during the changeover period.

Previously, Frank Matischek had been the Production Controller of an equivalent plant in the States. His experience there had led him to hold some very definite ideas about the programming of manufacturing operations. At his first management meeting in December 2011 he had made the following remarks;

“Every manufacturing business has a production scheduling problem at the heart of which lies a series of unknowns. The primary unknown is the sales forecast, with other unknowns being the various costs such as the cost of carrying the inventory, the cost of lost sales due to running out of inventory or failure to meet promised delivery dates. Manufacturing people have been wrestling with these problems for years with a tendency to blame all their troubles on insufficient or inaccurate forecasting. I think that putting the blame on something beyond your control is an easy way to avoid taking action to solve your own problem. We in the Pizza Division of KT raised particular hell with our marketing people for poor forecasting which had caused the factory to jump around haphazardly like a marionette attached to a perpetual motion machine. We screamed about the high cost involved in rapid and radical changes in schedule, the need for production levelling to keep the union out of our hair, and the general inability of people to predict next month's sales with any reasonable degree of accuracy. It is the conflict of three basic but divergent interests which results in these problems, and these lie in the areas of marketing, finance and manufacturing.

Marketing is concerned only with having goods available at all times and in the proper mix to prevent any possibility of a lost sale from inability to deliver. Thus their interest in sales forecasting for production scheduling is normally selfish, that is, forecasting need only be done to provide ample finished goods inventory. Finance, on the other hand, wants accurate forecasts to prepare budgets and profit estimates, and wants zero, or minimum, finished goods inventory, to keep carrying cost low and return on investment up. Manufacturing, however, is interested primarily in keeping one schedule and mix running as long as possible.”

### **Marketing considerations**

Perfect Pizzas produced and sold three basic types of pizza adapted only slightly for different markets, a 'Pepperami-mixed' type, a Vegetarian pizza, and a Basic Cheese type.

Forecasting was notoriously difficult because of the marked seasonality of pizza sales. Typically, the August low point was around 60% of the December peak. Forecasts of the retail sales of each pizza were made every month for a four-month period ahead. Also every quarter a four-quarter forecast was made. At the monthly sales/production meeting these forecasts were used to agree a month by month production plan with the plant manager.

### **Manufacturing considerations**

The production process consisted of three stages - dough manufacture, assembly, and packing/freezing. Dough manufacture was capital intensive with a capacity limit of 2.5 tonnes per hour. The assembly process was labour intensive with capacity depending on how the lines were staffed, up to a maximum with the current line configuration of 4 tonnes per hour. The packing/freezing stage was mainly automated with a capacity of 4 tonnes per hour. Frank Matischek had said his plant now had a 5-day capacity of about 165 tonnes per week (working with 2 eight hour shifts per day).

The plant was heavily unionised but labour relations had been generally good for the last few years. The company's employment record had been good, with no redundancies and a minimum of 4 weeks' notice given for any working practice change or overtime. Wage rates were about average for the area, but fringe benefits like canteen facilities were better than average. The whole plant shut down for the last two weeks in July and the first in August.

### **Fixing the production programme**

January 2012 saw the Sales Division formed and Frank Matischek's first production budget meeting. This was the meeting at which the guide-lines would be agreed between production and sales for production volumes over the coming year, and a preliminary overall production plan 'penciled in'.

Frank Matischek rather shocked the meeting by making what some regarded as a 'delaying' proposal.

"I am firmly convinced that we could save considerable amounts of money by examining our production schedules. I propose that we set up a small working party to examine the costs involved in adopting a number of strategies, namely:

- a) keeping production levels constant and absorbing demand fluctuations by varying finished goods stocks;
- b) using overtime on an extensive basis in peak periods and allowing under-utilization of labour during slack periods;
- c) hiring an extra shift for peak production and laying them off later in the year, if necessary;
- d) exploring ways with sales and marketing which would even out the demand fluctuations"

Rather reluctantly the meeting agreed to postpone any decisions for two weeks while the working party examined Matischek's alternative 'strategies'.

### **The Working Party**

The Working Party met five days later and consisted of one representative from each of Production, Factory Accounts, Sales and Marketing, and Distribution (now in the Marketing Division). They had for consideration two documents - a Sales Forecast for 2012 and some brief information prepared by the Factory Accounts Department concerning each strategy. These two documents are shown in Appendices 1 and 2. In addition the production control representative tabled a preliminary analysis of production requirements based on the 2012 forecast. This is shown in Appendix 3.

The production control representative put his view of the problem:

“We have to tackle this problem in the right order; first we need to look at the actual level of output which will be needed over the year, then we can decide how, ideally, we might like to meet this output requirement. Lastly, we need to have some idea of how to increase or decrease output if our forecasts change, and under what circumstances we would break away from the production plan.”

## Appendix 1: Average weekly demand forecast for 2012

Month	Economy (t/week)	Standard (t/week)	Deluxe (t/week)	Total (t/week)
JAN	59	89	29	177
FEB	60	95	32	187
MAR	60	95	31	186
APR	65	97	32	194
MAY	58	84	29	171
JUN	50	75	25	150
JUL	50	75	25	150
AUG	50	75	25	150
SEPT	50	80	25	155
OCT	55	82	28	165
NOV	56	85	29	170
DEC	80	120	40	240

## Appendix 2: Preliminary costings

### *Cost of stocks*

Finished goods stocks are no longer a factory item. Previously we have charged at an annual rate of 30% of factory cost to include all warehousing and handling costs.

Current refrigerated warehouse capacity is 300 tonnes. Occasionally extra storage capacity is rented.

### *Overtime*

Current union agreements require 4 weeks' notice for any overtime. However, in practice some weekdays overtime can be arranged at shorter notice. Up to 2 hours a day can be worked over the 16 (2 x 8) hour weekday shifts. Weekday and Saturday overtime rates are 150% of standard rates. Sunday rates are 200% of standard rates.

### *Hire temporary workers*

Recruitment would incur costs but much of the 'personnel' effort required could come from existing resources. Productivity of new workers would also be low, but again this is difficult to quantify.

### **Appendix 3: Perfect Pizza 2012 volume planning**

(all figures are in tonnes)

	PRODUCTION WEEKS	SALES WEEKS	FORECAST		
			AVERAGE WEEKLY DEMAND	AVERAGE MONTH'S DEMAND	TOTAL CUMULATIVE DEMAND
JANUARY	4	4	178.8	715.2	715.2
FEBRUARY	3	4	188.6	754.4	1469.6
MARCH	4	5	187.0	935.0	2404.6
APRIL	4	4	196.0	784.0	3188.6
MAY	5	5	171.5	857.5	4046.1
JUNE	4	4	150.0	600.0	5246.1
JULY	3	4	150.0	600.0	5346.1
AUGUST	3	5	150.0	750.0	5996.1
SEPTEMBER	4	4	155.0	620.0	6616.1
OCTOBER	5	5	165.0	825.0	7441.1
NOVEMBER	4	4	170.0	680.0	8121.1
DECEMBER	4	4	240.0	960.0	9081.1

## **8.3 Suggested questions and answers to 'operations in practice' and short cases**

### **The London Eye**

Suggested questions...



1. What are the main design issues for the design of the London Eye?
2. What is the capacity of the London Eye?

### **What are the main design issues for the design of the BA London Eye?**

Many students living in the UK or continental Europe will be familiar with the now famous landmark of the BA London Eye, and a proportion will have personal experience of a “flight”. These can be a useful source of input to any class debate on this question, but are not essential. Hopefully, some students will have looked at the web site, and others may have read the British Airways London Eye (B) case in Chapter 16 of the textbook. Given this basic knowledge of the wheel, it should be possible to tackle this first question with sufficient background knowledge amongst the class groups.

#### *a. The initial design concept*

This was totally the brainchild of two young London architects who wanted to create something very special and spectacular for London to celebrate the millennium. Their concept was to build the world's largest diameter passenger-carrying wheel. But it was to be totally different from a normal Ferris wheel in several main ways...these should be easily identified by the students;

- The cabins were always to remain outside the wheel rim structure, to improve visibility, so could not be conventionally “hung” between two rim elements
- They would be fully air conditioned, fitted with high quality audio systems, and would have a high-tech stylish appearance.
- They would have unusually large areas of laminated, curved glass to provide the widest possible viewing angles, and a sense of flying
- The wheel was to be supported on one side only
- The supporting structure (an A-frame) was to be cantilevered out at an angle over the Thames
- (Later addition to the concept) The rim of the structure would be supported by tensioned steel cable spokes, eliminating the need for a mass of rigid steelwork lattices within the wheel. Because the cables are relatively thin, the rim would appear (particularly at night) to float in the air with very little support.
- The wheel would rotate continuously, NOT stopping for passengers to board or disembark. This dictated the speed of rotation, and hence the flight time for the initially proposed diameter; about thirty minutes per rotation.

Clearly, the main design objectives of the architects were to create a unique, aesthetically pleasing but practical tourist attraction, and to provide a spectacular new London landmark. But the final

product also had to be effective as an operations technology, processing millions of customers a year. Consideration therefore had to be given to the needs of the customers (passengers), for example:

- Explicitly safe (there can be 800 customers on board...2 Boeing 747s!)
- Easy to board (e.g. good customer flow)
- Enough time to enjoy the view and listen to guide
- Performs well (e.g. air conditioning and audio always working)
- Potentially delights, exceeds expectations
- Reasonable cost
- Completed, and in operation by 31 December 1999

*b. Trade-offs in the design*

To achieve all design objectives simultaneously, there are usually many trade-offs, and some of these can be easily identified by students. For example:

- For a given diameter, the rotation speed affects the capacity (passengers per hour). Faster rotation will increase capacity, reducing the cost per passenger (most operating costs are fixed), but will reduce the journey time and make boarding marginally more difficult, particularly for old and/or disabled people.
- For a given rotation speed, more capsules (e.g. 64, as originally conceived by the architects) would provide greater capacity, without the disadvantages described above. However, because of the complexity and sophistication of the capsules, this would very significantly increase the capital cost of the project, and would have required a stronger, heavier, and more expensive wheel structure. This would have affected the aesthetics of the wheel, and would have created a narrower vertical viewing angle for the passengers at certain points in the flight.
- Underlying these decisions is also a question of what the demand levels will become; there is little point in providing more capacity if there will only be sufficient demand to fill the BA London Eye capacity on a few days a year. (This is a long term capacity issue discussed in Chapter 6.)
- Although the large areas of glass in the capsules would provide the best possible view, this would be an expensive choice of material compared with the more rectangular and largely metal-based construction of conventional Ferris wheel “gondolas”. However, the high-tech aesthetic design should enhance the public image of the wheel, increasing demand and improving value...perhaps allowing higher ticket prices.
- There may be extra capital costs involved in completing the project by a totally fixed target date. Project objectives are discussed in Chapter 16. However, since this is a “millennium” project, there is high value to the main sponsor (British Airways) of completing on time. Conversely, there could be adverse publicity associated with project failures and late completion, as discussed in BA London Eye (B).

*c. Operations-based design objectives*

The above design objectives for the BA London Eye could also be re-classified into the five operations performance objectives. Examples are shown in Table 1 below:

*Table 1: Examples of Design objectives for BA London Eye*

<b>Performance objective</b>	<b>Design of the product / service</b>	<b>Design of the process</b>
Quality	<ul style="list-style-type: none"><li>• Exceptional aesthetics</li><li>• Strong, durable</li><li>• Good, uninterrupted views</li><li>• Unquestionably safe</li><li>• Comfortable ride (no sway)</li></ul>	<ul style="list-style-type: none"><li>• Resembles air travel</li><li>• Professional, smart staff</li><li>• Informative</li><li>• Capsules regularly cleaned</li><li>• Clear reservation system</li></ul>
Speed	<ul style="list-style-type: none"><li>• Short lead time for the design and construction</li></ul>	<ul style="list-style-type: none"><li>• No long queues</li><li>• Clear, fast and fair flows boarding / disembarking</li></ul>
Dependability	<ul style="list-style-type: none"><li>• Available as advertised</li><li>• Completed by target date</li></ul>	<ul style="list-style-type: none"><li>• Boarding as per timed ticket</li><li>• No unscheduled downtime</li></ul>
Flexibility	<ul style="list-style-type: none"><li>• No product flexibility reqd.</li><li>• Volume flexibility to cope with seasonal demand</li></ul>	<ul style="list-style-type: none"><li>• Caters for all ages / abilities</li><li>• Individual questions answered</li></ul>
Cost	<ul style="list-style-type: none"><li>• Affordable, good value</li></ul>	<ul style="list-style-type: none"><li>• Low operating costs</li></ul>

*d. Process design principles*

The BA London Eye was designed as a high volume, low variety, high variation, high visibility service operation. The process design implications are therefore that a mass service will be required with the following characteristics:

- There will need to be a great emphasis on process design, including such elements as the “timed admissions booking system”, customer flow management around and onto the “flight”, the service processes during the flight, cleaning routines, etc.
- The processes will be highly standardised, with little opportunity (or time) for customisation.
- Flow (of customers) will be continuous, and is in reality a circular product layout. There are no alternative routes, every customer will be forced to follow the same sequence of events. No time is lost at change-overs (unlike conventional Ferris wheels which stop for customer unloading / loading).

- Dedicated process technology: the BA London Eye was designed for one purpose only and is not adaptable.
- The staff can be trained with the skills needed to operate the prescribed system. There may be significant division of labour and specialisation (e.g. flight attendant). All eventualities, including emergencies, are rehearsed.

Variation in demand would be anticipated for any tourist leisure attraction, although London is a popular destination throughout the year. Shorter-term weather conditions will influence levels of casual demand. The operation, therefore, must be able to operate to the same quality standards even when demand is significantly below the design capacity. Conversely, demand levels must be managed to avoid excessive queues forming and blocking access by the customers who have made a reservation.

The particular skills required for running such an operation were provided by a specialist leisure company, Tussauds.

### **What is the capacity of the London Eye?**

#### **1. Capacity analysis**

- Hourly Capacity.

The wheel rotates one full revolution per 30 minutes. Thus the hourly capacity is:

$$2 \text{ revs} \times 32 \text{ capsules} \times 25 \text{ passengers / capsule} = 1600 \text{ passengers / hour}$$

- Summer Weekly Capacity (April to mid-September)

The first passengers can board at 10:00am, and can be scheduled to board continuously up to 10:00pm (the end of the 9:30 to 10:00pm slot). Thus there are 12 hours of boarding, giving a weekly capacity:

$$7 \text{ days} \times 12 \text{ hours} \times 1600 \text{ passengers} = 134400$$

- Winter Weekly Capacity (mid-September to March)

The last slot is brought forward to end at 6:00pm. Thus the capacity is

$$7 \text{ days} \times 8 \text{ hours} \times 1600 \text{ passengers} = 89600$$

- Annual Design Capacity

There are 365 days / year = 52 weeks + 1 day

The attraction is closed on Christmas Day (winter)

There are the following days in each summer month

Apr	30
May	31
Jun	30
July	31
Aug	31
Sep	30 (half month =15)
Total summer period = 168 days = 24 weeks	

Thus the annual capacity is Summer:  $24 \times 134400 = 3225600$

Winter:  $28 \times 89600 = 2508800$

Total = 5734400 (say 5.7million)

- Maximum Theoretical Design Capacity

Assuming 52 weeks at 168 hours per week

Capacity =  $52 \times 168 \times 1600 = 13977600$  (say 14.0 million)

- Number of rotations in normal year:

Summer:  $24 \text{ weeks} \times 7 \text{ days / week} \times 24 \text{ revs / day} = 4032$

Winter:  $28 \text{ weeks} \times 7 \text{ days / week} \times 16 \text{ revs / day} = 3136$

Total = 7168

The press release referred to 6000 revolutions per year, perhaps in anticipation of the need for planned maintenance periods, or unplanned breakdowns.

### Capacity utilisation

Utilisation of equipment (such as the BA London Eye attraction) is usually considered particularly important in high volume, low variety, capital-intensive operations. It is a crude measure of the revenue-earning performance of the asset.

The definition of utilisation is not explained until chapter 11, page 367 in the 4th edition. However, students should be able to follow the formula:

Utilisation = actual output / design capacity

(In this case, the actual output is not known, but is forecast)

Anticipated passenger numbers for 2000 are 2.2 million.

Design capacity = 5.7 million for a whole year, but this must be adjusted for the late start (not ready until February)

January, at 31 days, provides  $31 \times 8 \text{ hours} \times 1600 \text{ passengers / hour of capacity}$ ,  
 $= 396800$  (say 0.4 million)

Thus annual capacity for 2000  $= 5.7 - 0.4 = 5.3$  million

Thus anticipated utilisation  $= 2.2 / 5.3 = 41.5\%$

Students will usually understand that the only reason for *anticipated* low utilisation is the forecast lack of demand at off-peak times. However much this is based on sound market research, the population's and tourists' actual behaviour may in practice provide more (or less) demand. It is possible, for example that people may be prepared to attend at off-peak times simply to get a flight, although there is no price incentive for them to do so!

Once operating, there could be loss of utilisation for operational reasons. For example, there may have to be periods of non-operation caused by:

- Urgent maintenance requirements
- Security alerts
- Unsuitable operating conditions (eg high winds, blizzards)

Students may not realise that utilisation is also affected by incomplete occupancy of each capsule, even during busy periods. This can be caused by a number of factors, each of which should be managed, to a greater or lesser extent. Examples include:

- Group bookings; some passengers may be unwilling to travel with large groups of strangers, particularly if these are intoxicated! Conversely, large groups (eg corporate events) may resist the inclusion of small numbers of strangers on the flight.
- Late arrivals due to travel problems; insufficient numbers available for a given time slot.
- Shortage of passengers at the beginning of a time slot, since some passengers may believe that they simply have to turn up any time during the slot.
- Slower loading of disabled passengers, and possibly reduced capsule occupancy due to space taken by wheelchairs
- "No-shows" (customers who do not turn up). These are not a problem as they will have paid in advance. Care must be taken in recording loss of utilisation, since they effectively allow other fare-paying passengers to occupy their slot (double earnings!)

### **Revenue-earning potential and yield management**

This question could be excluded if the students are only working on basic OM analysis. However, it is useful for students studying more general courses with marketing content, or if the tutor wants OM students to consider demand management issues.

Answers to this question will require the students to make a number of assumptions, which they should make explicit. Students should not, therefore, expect to arrive at accurate answers, but within about 10%, say.

2.2 million customers were expected for 2000

Assuming that:

50% (1100000) are full fare adults	@ £7.45	revenue =
40% (880000) are children	@ £4.95	=
10% (220000) are senior citizens	@ £5.85	=
Estimated Total Revenue =		

Students may wish to check the sensitivity of this to varying percentages of children and senior citizens. The actual proportions were not known in advance, and could be judged only by experience of similar attractions in London, such as the Tower of London.

Students should also make some assumptions about the proportion of passengers receiving each type of group discount, and the proportion paying the fare increase post-June 2000.

The purpose of this analysis is to raise students' awareness of the importance of yield management for 2001 onwards. In every way, the BA London Eye meets the conditions suggested. With an operating capacity of 5.7 million and utilisation of only 41.5%, there is huge potential for yield management to increase revenue, contribution and profit. Students will suggest a range of approaches, similar to those used by airlines, but not all will be appropriate (e.g. different classes and service types), and some will even risk overall loss of revenue (e.g. off-peak discounting at the walk-in ticket office). Students should quickly come to appreciate that successful yield management requires good levels of data on demand patterns for different segments, and very careful planning. It also needs a clear understanding of the price elasticity of demand for each segment, and some market research on specific potential markets not targeted in 2000.

Information requirements for yield management include:

- Hourly, daily, weekly, monthly volumes
- Sources of this demand: bookings (by origin, such as by phone, booking agent, etc) and at the on-site ticket office, as above
- Segment volumes, as above

- Demographics of passengers, as above
- Weather conditions including the forecast
- Records of other events likely to affect demand
- Records of advertising and promotional activities (time, date, spend)
- Results of experiments with price changes (including the one in June 00)
- Etc

There is no information in the case on the actual fluctuation in demand during 2000. However, experience will indicate that demand, and hence utilisation will peak during the middle of the day, weekends and holidays, spring through autumn. There will be spare capacity at other times, when pre-booking discounts and promotions could be used to stimulate demand. Specific targets such as school parties could be encouraged by these mechanisms and perhaps also using special educational service packages. Corporate bookings can be targeted for weekday evenings.

Care will have to be taken to avoid any impression that BA London Eye was desperate to get more customers (sending out adverse signals such as happened with The Millennium Dome at Greenwich). It must also be consistent with BA's image of premium quality travel, so any large influx of groups looking like charter flight passengers heading for The Canary Islands should be avoided!

It is questionable why group discounts are offered at any time, including peaks. Students could debate the practicability of discounts applying only to off-peak times. They could also discuss the applicability of "standby" passengers and the use of "bucket shops" which sell spare capacity at very low prices.

## **Producing while the sun shines**

Suggested question...

1. How should a business work out what it is prepared to pay for these increasingly sophisticated weather forecasts?

### **How should a business work out what it is prepared to pay for these increasingly sophisticated weather forecasts?**

This all hinges around the costs associated with being wrong. For example, if a business making cottage cheese produces 10 per cent too much in one period, what costs will it incur? The main cost in fact will be the increased likelihood that early production of the product will increase the chances that it is not sold before its sell by date in the supermarket. Similarly, if it under-produces by 10 per cent, what will be the financial penalties? Here the costs are likely to be a reduction in potential



revenue because the company's brand was not available in the supermarket when customers wanted to purchase it. Going through these calculations gives the company an approximate idea of the cost of being wrong by 10 per cent. Now compare this with the cost of buying a sophisticated weather forecast. Of course the weather forecast could be itself wrong. But at least the company can ask some basic questions such as, 'Suppose the weather forecast meant that we were only wrong by (say) 5 per cent instead of 10 per cent, would half the cost of being wrong by 10 per cent be more or less than the price we pay for the weather forecast?' If the price of the weather forecast is lower than that the question to be asked then becomes, 'What are the chances that the weather forecast will reduce our risk of being wrong to 5 per cent instead of 10 per cent?' None of these questions give a definite answer (though there are more sophisticated probability based techniques which can help) but they do allow for a more systematic appraisal of the investment in the forecast.

## **Seasonal salads**

Suggested questions....

1. What approach(es) does the company seem to take to its capacity management?
2. What are the consequences of getting its planting and harvesting programmes wrong?

### **What approach(es) does the company seem to take to its capacity management?**

The company mainly chases demand. This is because it has very little scope for doing anything else. It cannot keep production of lettuce level because they do not grow at the same speed throughout the year, nor can the product be put into inventory during times when production exceeds demand. It has a very limited shelf life. It appears to chase demand in a number of ways. First, it 'subcontracts' to its operation in Spain. Technically this isn't subcontracting because it owns the operation, but as far as the UK demand is concerned it is not using its own local facilities. The advantage of Spain is that it can grow product during the time when the UK cannot. The disadvantage with using the Spanish operation is that there will be a time lag between picking the crop and it arriving in UK supermarkets. Given that the supermarkets can change their mind (because of weather fluctuation) at very short notice this poses some risks for the grower. The lettuce could already be picked and on its way to the UK when the weather turns bad and supermarkets cancel their orders. The company also uses overtime and underutilisation to cope with demand fluctuations. Its staff work through the night under floodlights if necessary to pick the lettuce. Finally, the company uses temporary seasonal staff to supplement its full-time employees.

### **What are the consequences of getting its planting and harvesting programmes wrong?**

Very considerable. Certainly higher than for (say) a manufacturing operation. If, in a manufacturing operation, production has to be reduced, then the machines stop and the staff do something else. The material which is being processed in the manufacturing operation does not usually deteriorate. With products such as lettuce, the raw materials (the lettuce) have to be picked before a certain time or they spoil. To some extent the growing rate can be slowed down by adjusting the temperature (if they are grown under glass) but in the fields there is not much flexibility to slow down production. Thus, excess capacity is a direct cost because the product cannot be recovered once grown and wasted. Similarly, there is a limit to the extent to which lettuces can be accelerated through their growing period if demand is greater than expected.

## **Working by the year**

Suggested question....

### **1. What do you see as being the major advantages and disadvantages to both the company and the staff of adopting the Annual Hours Work Plan?**

As far as the company is concerned,

- Advantages – include the predictability of their wage bill. Excessive and unpredictable overtime rates can be avoided. It also means that they can legitimately call on staff to change their work plans at very short notice.
- Disadvantages – include the lack of staff flexibility *beyond a certain point*. Once the allocated work time for a period has been used up staff may not be willing to work further. Alternatively, they may demand very high rates for working beyond the agreed limit.

As far as staff are concerned,

- Advantages – usually include a higher and predictable basic wage (to compensate for lack of overtime, etc.). Also the less direct advantage that the increased flexibility to the company should ensure a more stable future for the company and therefore prolonged employment.
- Disadvantages – include the short-term flexibility which they may have to adopt. So the company may ask them to work extra time at very short notice. This may not be important unless they have other appointments or holiday plans etc.

## **Getting the message**

Suggested questions....

**1. What seem to be the advantages and disadvantages of the strategy adopted by Hallmark Cards?**

The main advantage is that non-occasion cards increase the company's total volume which both increases the absolute amount of business and makes the fluctuations due to seasonal cards less important. The disadvantages come from the complexity associated with a vastly increased product range. This will be more expensive for the manufacturing operation which makes them, the distribution operation which handles the orders and delivers the cards to shops and the shops themselves.

**2. What else could it do to cope with demand fluctuations?**

The strategy described in the box is one of 'managing demand'. This, it seems to be doing fairly effectively. It could however perhaps push this strategy further and invent even more occasions to sell cards, or it could extend its operations overseas. For example, occasions like Mothers Day etc. are often on different dates in different parts of the world. Unfortunately other occasions like Christmas are (more or less) at the same time of the year everywhere. In addition, it could adopt a level capacity plan and/or a chase demand plan. In fact it may very well do both these things to some extent. The box just highlights one part of the company's overall strategy.

## **Managing queues at Madame Tussaud's, Amsterdam**

Suggested questions....

**1. Generally, what could Madame Tussaud's do to cope with its demand fluctuations?**

The problem with operations such as this one is that their capacity is relatively fixed. The absolute size of the attraction cannot be varied in the short-term at all. Its main strategy therefore is to queue its customers when demand exceeds capacity. As the box indicates, the customers are entertained by assorted individuals. However, presumably Madame Tussaud's could do more itself to actively engage in entertaining its clients. It may even be able to pre-sell tickets, sell merchandise, train customers in what to expect, and so on. Within the attraction, although it cannot flex its physical size, it could adjust the number of staff on duty. Extra staff could assist customers to get the most out of the attraction as quickly as possible during busy times, thus effectively increasing the capacity of the attraction. Conversely, staff could be reduced during slack periods.

**2. What does the operation do to make queuing relatively painless? What else could it do?**

We already touched on ways in which Madame Tussaud's could increase its revenue and manage its customers' expectations during the queuing time. However, in addition it could also provide more tangible benefits. For example, in periods when demand was particularly heavy it could distribute free ice-cream, thus delighting its customers. It could also organise entertainment which relates to what

the customers will see inside. In periods of fine weather for example, it could perhaps move some wax figures outside so that the photographer could take photographs during the queuing period.

## 8.4 Further examples

### Holly farm

In 2003, Charles and Gillian Giles decided to open up their farm to the paying public, in response to diminishing profits from their milk and cereals activities. They invested all their savings into building a 40 space car park and an area with spaces for six 40-seater busses, a safe viewing area for the milking parlour, special trailers for passengers to be transported around the farm on guided tours, a permanent exhibition of equipment, a “rare-breeds” paddock, a children’s adventure playground, a picnic area and a farm shop. Behind the farm shop they built a small “factory” making real dairy ice cream, which also provided for public viewing. Ingredients for the ice cream, pasteurised cream and eggs, sugar, flavourings, etc, were bought out, although this was not obvious to the viewing public.

Gillian took responsibility for all these new activities and Charles continued to run the commercial farming business. Through advertising, giving lectures to local schools and local organisations, the number of visitors to the farm increased steadily. By 2006 Gillian became so involved in running her business that she was unable to give so much time to these promotional activities, and the number of paying visitors levelled out to around 15,000 per year. Although the farm opened to the public at 11.00 am and closed at 7.00 pm after milking was finished, up to 90 per cent of visitors in cars or coaches would arrive later than 12.30 pm, picnic until around 2.00 pm, and tour the farm until about 4.00 pm. By that time, around 20 per cent would have visited the farm shop and left, but the remainder would wait to view the milking, then visit the shop to purchase ice cream and other produce, and then depart.

Gillian opened the farm to the public each year from April to October inclusive. Demand would be too low outside this period, the conditions were often unsuitable for regular tractor rides, and most of the animals had to be kept inside. Early experience had confirmed that mid-week demand was too low to justify opening, but Friday through Monday was commercially viable, with almost exactly twice as many visitors on Saturdays and Sundays than on Fridays or Mondays. Gillian summed up the situation. *“I have decided to attempt to increase the number of farm visitors in 2007 by 50 per cent. This would not only improve our return on ‘farm tours’ assets, but also would help the farm shop to achieve its targets, and the extra sales of ice cream would help to keep the ‘factory’ at full output. The real problem is whether to promote sales to coach firms or to intensify local advertising to attract more families in cars. We could also consider tie-ups with schools for educational visits, but I would not want to use my farm guides staff on any extra weekdays, as Charles needs them three days per week*

*for 'real' farming work. However, most of the farm workers are glad of this extra of work as it fits in well with their family life, and helps them to save up for the luxuries most farm workers cannot afford."*

### **The milking parlour**

With 150 cows to milk, Charles invested in a "carousel" parlour where cows are milked on a slow-moving turntable. Milking usually lasts from 4.30 pm to 7.00 pm, during which time visitors can view from a purpose-built gallery which has space and explanatory tape recordings, via headphones, for twelve people. Gillian has found that on average spectators like to watch for ten minutes, including five minutes for the explanatory tape. *"We're sometimes a bit busy on Saturdays and Sundays and a queue often develops before 4.00 pm as some people want to see the milking and then go home. Unfortunately, neither Charles nor the cows are prepared to start earlier. However, most people are patient and everybody gets their turn to see this bit of high technology. In a busy period, up to 80 people per hour pass through the gallery".*

### **The ice cream 'factory'**

The factory is operated 48 weeks per year, four days per week, eight hours per day, throughout the year. The three employees, farm workers' wives, are expected to work in line with farm opening from April to October, but hours and days are by negotiation in other months. All output is in one litre plastic boxes, of which 350 are made every day, which is the maximum mixing and fast-freezing capacity. Although extra mixing hours would create more unfrozen ice cream, the present equipment cannot safely and fully fast freeze more than 350 litres over a 24 hour period. Ice cream that is not fully frozen cannot be transferred to the finished goods freezer, as slower freezing spoils the texture of the product. As it takes about one hour to clean out between flavours, only one of the four flavours is made on any day. The finished goods freezer holds a maximum of 10,000 litres, but to allow stock rotation, it cannot in practice be loaded to above 7,000 litres. Ideally no ice cream should be held more than six weeks at the factory, as the total recommended storage time is only twelve weeks prior to retail sale (there is no preservative used). Finished goods inventory at the end of December 2007 was 3600 litres.

Gillian's most recent figures indicated that all flavours cost about £4.00 per litre to produce (variable cost of materials, packaging and labour). The factory layout is by process with material preparation and weighing sections, mixing area, packing equipment, and separate freezing equipment. It is operated as a batch process.

### **Ice cream sales**

The majority of output is sold through regional speciality shops and food sections of department stores. These outlets are given a standard discount of 25 per cent to allow a 33 per cent mark-up to the normal retail price of £8.00 per litre. Minimum order quantity is 100 litres, and deliveries are made by Gillian in the van on Tuesdays. Also having been shown around the farm and "factory", a large

proportion of visitors buy ice cream at the farm shop, and take it away in well-insulated containers that keep it from melting for up to two hours in the summer. Gillian commented *“These are virtually captive customers. We have analysed this demand and found that on average one out of two coach customers buys a one-litre box. On average, a car comes with four occupants, and two 1 litre boxes are purchased. The farm shop retail price is £2.00 per box, which gives us a much better margin than for our sales to shops”*.

In addition, a separate, fenced, road entrance allows local customers to purchase goods at a separate counter of the farm shop without payment for, or access to, the other farm facilities. *“This is a surprisingly regular source of sales. We believe this is because householders make very infrequent visits to stock up their freezers almost regardless of the time of year, or the weather. We also know that local hotels also buy a lot this way, and their use of ice cream is year-round, with a peak only at Christmas when there are a larger number of banquets.”* All sales in this category are at the full retail price (£8.00). The finished product is sold to three categories of buyers. See table 1 (Note – (a) no separate record is kept of those sales to the paying farm visitors and those to the “Farm Shop only”, (b) the selling prices and discounts for 2008 will be as 2007, (c) Gillian considered that 2007 was reasonably typical in terms of weather, although rainfall was a little higher than average during July and August.)

**Table 1 Analysis of Annual Sales of Ice Cream (£000s) from 2003 to 2007, and Forecast Sales for 2008.**

	2003	2004	2005	2006	2007	2008 forecast
<b>Retail shops</b>	32	104	156	248	300	260
<b>Farm shop total</b>	40	64	80	100	108	160
<b>Total</b>	72	168	236	348	408	420

Table 2 gives details of visitors to the farm and ice cream sales in 2007. Gillian's concluding comments were *“We have a long way to go to make this enterprise meet our expectations. We will probably make only a small return on capital employed in 2007, so must do all we can increase our profitability. Neither of us want to put more capital into the business, as we would have to borrow at interest rates of up to 15 per cent. We must make our investment work better. As a first step, I have decided to increase the number of natural flavours of our ice cream to ten (currently only four) to try and defend the delicatessen trade against a competitor's aggressive marketing campaign. I don't expect that to fully halt the decline in our sales to these outlets, and this is reflected in our sales forecast”*.

**Table 2 Records of Farm Visitors and Ice cream Sales (in £'000) in 2007**

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
Total number of paying farm visitors	0	0	0	1,200	1,800	2,800	3,200	3,400	1,800	600	0	0	14,800
Monthly ice cream sales	18	20.2	35	26.8	36	50.2	50.6	49.2	39	25.6	17.4	40	408.8

### Questions

1 Evaluate Gillian's proposal to increase the number of farm visitors in 2008 by 50 per cent. (You may wish to consider: What are the main capacity constraints within these businesses? Should she promote coach company visits, even if this involves offering a discount on the admission charges? Should she pursue increasing visitors by car, or school parties? In what other ways is Gillian able to manage capacity? What other information would help Gillian to take these decisions?)

2 What factors should Gillian consider when deciding to increase the number of flavours from four to ten?

(Note: For any calculations, assume that each month consists of four weeks. The effects of statutory holidays should be ignored for the purpose of this initial analysis.)

### Holly Farm - teaching notes

#### Synopsis

Over a period of six years, the owners of Holly Farm have developed two additional complementary businesses. The first is a service operation opening up the farm to paying visitors who can observe farming activities and enjoy tours, walks and exhibits; the second an ice-cream manufacturing facility, which sells to farm visitors and through the retail trade.

The case allows students to explore some capacity constraints in a service business, and to compare the capacity with demand forecasts. The teacher will be able to highlight the dangers of ignoring

changes in "mix" of demand, and the inappropriate use of averaged data. Students can explore options for flexing capacity, managing demand, and target marketing to achieve better balance between capacity and demand in a very seasonal business.

They can also examine the role of inventory in the manufacture and supply of ice cream, with various seasonalities associated with different markets. Again, there are capacity constraints in production and storage.

The case illustrates the dangers that can arise when apparently sensible marketing policies ignore operational capabilities and constraints.

### **Indicative questions**

1. Evaluate Gillian's proposal to increase the number of farm visitors in 2008 by 50 per cent.

You may wish to consider:-

What are the main capacity constraints within these businesses?

- Should she promote coach company visits, even if this involves offering a discount on the admission charges?
- Should she pursue increasing visitors by car, or school parties?
- In what other ways is Gillian able to manage capacity?
- What other information would help Gillian to take these decisions?

2. What factors should Gillian consider when deciding to increase the number of flavours from four to ten?

Note: For any calculations, assume that each month consists of four weeks including holidays (statutory holidays) should be ignored for the purpose of this initial analysis.

### **Introduction**

Most students should be well-prepared to provide data and calculations on all the detail provided in the case. However, before this, it is important to overview the business; its objectives, constraints and forecasts:



### **Objectives**

- Both Gillian and Charles need to improve the profitability of their business
- Charles does not want to disturb the farming business
- Gillian believes that growth will provide extra profit

### **Constraints**

- The Giles' don't want to invest more capital on the business
- The farm workers and their spouses are provided extra income from the new activities; they may have become dependent on this money and used to the pattern of employment.
- Growth may be restrained by competitor action (other farms/other ice cream manufacturers) and affected by external factors (the economy, climatic conditions, etc.)

### **Forecasts**

The case does not say exactly how the forecasts were derived. However, it is clearly based on a subjective view of:

- a) Historical growth, projected forward
- b) Policy to expand farm visitors by 50 per cent
- c) Realistic view of effect of competitor attack on ice cream retailers.

Exhibit 11.1 illustrates the historical and forecast sales of ice cream in each segment, showing the result of these influences. Students will quickly forget that, despite its credibility, a forecast is uncertain. Yet we often have to plan on the basis of such figures!

Some students will also note, either at this stage, or later, that the ice cream forecast is expressed in sales (money) whereas production is in litres. Where the same product is sold at several different prices, and the mix changes, this could be misleading.

### **Analysis of Demand for the Farm Visits**

Whilst Question 1 asks the student to analyse various capacities, this is only relevant in the context of knowledge of demand. The data on farm visitors is expressed in numbers. The first task is to highlight the pattern of the demand for the service:

### *Seasonality*

Table 11.4 highlights the extreme seasonality of the service over the year. (Graphed here as Exhibit 11.2)

#### *Weekly Demand Pattern*

The case states that twice as many visitors come on Saturdays and Sundays than on Fridays and Mondays.

$$\begin{aligned}\text{Peak demand in Aug 2007} &= 3400 \text{ visitors} \\ \text{Weekly demand Aug 2007} &= 850 \\ \text{Therefore Sat or Sunday demand} &= 1/3 \text{ of } 850 \\ &= 283\end{aligned}$$

This demand pattern is shown here in Exhibit 11.3. *But* it is an *average*; reality will be that some Saturdays and Sundays are busier - dependent on weather, alternative attractions, etc.

#### **Daily Demand Pattern**

Exhibit 11.4 indicates the pattern of attendance over the day of the peak 283 people. It is only indicative for discussion purposes.

2008 Forecast:

It could be argued that if the business continues to be promoted in the same way, only more, the demand pattern will be unchanged, but will increase by 50 per cent. This would result in peak daily demand of

$$283 \times 1.5 = 424 \text{ people}$$

#### **Capacity analyses**

##### 1) *Car parking*

$$\begin{aligned}40 \text{ cars} \times 4 \text{ people} &= 160 \\ 6 \text{ buses} \times 40 \text{ people} &= \underline{240} \\ \text{Maximum} &= 400 \text{ people}\end{aligned}$$

A discussion should note:-

- This is mix dependent (cars and coaches)
- All arrivals on site during afternoon, therefore only one use of each space per day (unlike most car parks)
- There will be a problem in peak days (Saturdays and Sundays) in peak season (June, July, August)

2) *Milking parlour viewing*

150 minutes only (fixed viewing period)

2.5 hours x 80 people/hour = 200 people (maximum)

This is already exceeded in June, July, August on Saturdays, Sundays.

Note that this is the capacity when busy, but the "normal" capacity, based on ten minute batches of twelve people is only 180 people. Presumably, the figure of 200 only occurs when customers are under pressure to pass through the gallery. This is known as the "coping zone", where operations concentrate on the core service only.

3) *Ice cream output*

Currently produced on a "Level Capacity" basis, 4 days a week:

$$\begin{aligned}
 350 \text{ litres/day} &= 350 \times 48 \times 4 \\
 &= 67200 \text{ litres per year} \\
 &= 5600 \text{ (per month)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Sales in 2007} &= \frac{\pounds 300000}{\pounds 6.0 / \text{litre}} + \frac{\pounds 108000}{\pounds 8.00 / \text{litre}} \\
 &= 50,000 + 13500 \\
 &= 63500 \text{ litres}
 \end{aligned}$$

Thus, in 2007 sales were 95% of capacity.

$$\begin{aligned}
 50\% \text{ extra visitors in 2008} &= 7400 \text{ people} \\
 &= 3700 \text{ litres extra}
 \end{aligned}$$

However, that in itself is not a problem, as retail sales are forecast to go down, see Exhibit 11.5. The real problem is that seasonality has been enhanced, since farm is only visited in 7 months of year.

#### Limitations of ice cream production

- Fast freezer capacity (key process-max 350 litres / 24 hours)
- Storage capacity (7000 litres effective)
- Workers only available/requested 4 days/week
- Capacity planning options (level, chase, mixed plans)

#### 4. Analysis of target markets

##### 1) *Promotion of coach visitors*

#### Advantages

- can schedule arrival time to suit service
- will come even if weather is bad
- could be programmed for Friday/Monday only
- occupies less car parking space/person
- simple target market
- could have specially-designed service package (e.g. without viewing gallery)
- promotion is responsibility of coach companies

#### Disadvantages

- "lumps" of demand may overload service at various times/points.
- may have to discount admission price.

##### 2) *School parties*

#### Advantages

- avoids peak periods of July/August and w/ends
- could be phased timing to avoid overlapping parties
- schools could provide some of the supervision (customer involvement)
- as for coach visitors
- promote service - tell families/friends
- agreed departure prior to milking

#### Disadvantages

- won't buy so much ice cream (if any)
- may upset service package for other visitors
- may be satisfied by one visit, and not bring back family

#### 3) *By car*

- few problems except car park space, but
- no control over arrival time (and Sat/Sun peaks)

#### 4) *Manage capacity/demand*

Since Gillian is unwilling to increase capital investment, and the service cannot be stored, she must alter process efficiency at bottle-neck, and make more effort to manage demand, ideally to smooth it, for example:-

- booking system
- promote Friday/Monday
- alternative services - film/video milking
  - tea shop restaurant
  - other animal care (e.g. goat milking)
  - talks
- prices and discounts
- make customer wait (queuing with distractions, for example baby animals, aviary etc.)
- special late opening in summer
- promote "early morning" tours with alternative attractions.

Capacity - (farm tours)

- open up midweek for specific coach parties with use of
  - part-timers (e.g. retired workers)
  - overtime
- overspill car park on fields (summer only)

#### Capacity - (ice cream)

- mixed plan, with extra production Tuesday / Thursday
- this would obviate the need for extra finished goods freezers.

#### 5) *Other information that would help Gillian to manage capacity better*

- records of sales to paying farm visitors and to "farm shop only"
- records of coach/car demand
- effect of weather patterns on each type of sales
- customer's tolerance to queuing
- demand/appropriate price for other sizes of ice cream
- price elasticity of demand for entrance fee
- customer survey needed-what service package they want? (customers and non-customers)
- demographic data on target customers
- survey of needs of delicatessen trade/competitors' offerings

#### **Effects of increasing number of flavours from 4 to 10**

##### *Disadvantages*

- increase in variety, decrease in volume per flavour = product proliferation
- might increase retail sales - but will it affect farm shop sales?
- stock rotation problems (due to limited freezer capacity)
- extra inventory (greater variety of raw materials and finished goods)
- possible lost capacity due to extra set-ups (also note that visitors don't want to see set-ups!)  
(e.g. 1 set up = 12.5% of daily capacity)...

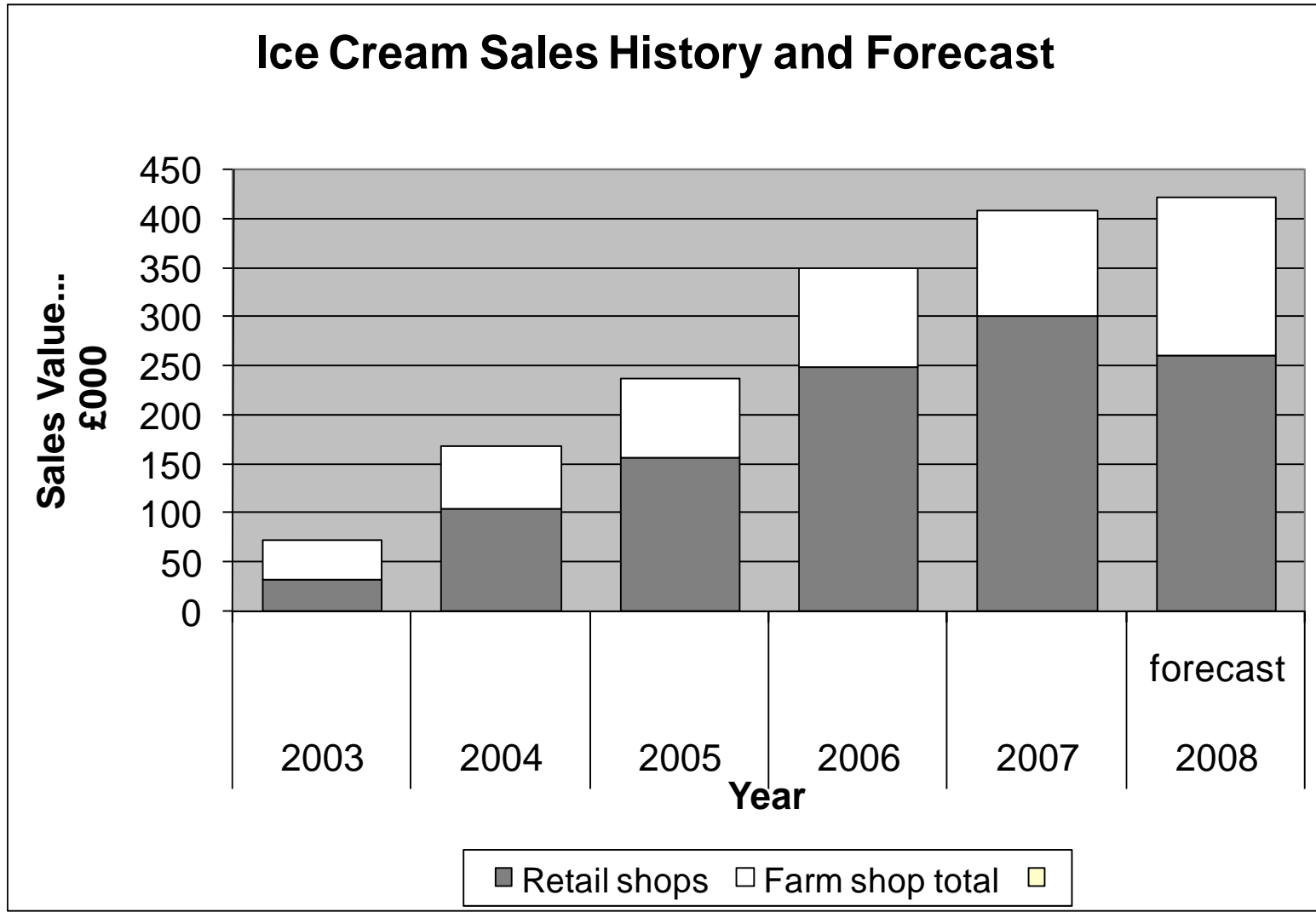
BUT if mixing is not a bottleneck, there may be no change in capacity!

- more complex
  - supervision
  - co-ordination
  - packaging control
  - scheduling

- increased costs due to above
- effect on quality control (increased chance of errors)
- priority when stocks are low? (to retail or farm shop?)
- need for increasing freezer capacity in shop
- need for market information (preferences, forecasts, etc.)
- move away from possibilities of line production in the future
- proof of competitive advantage? - trial markets all outlets, or just shops?

#### *Advantages*

- possible extra sales and contribution
- defend delicatessen trade (competitive advantage)
- potentially, more return customers (to try other flavours).





## Holly Farm: Monthly Visitor Numbers 2007

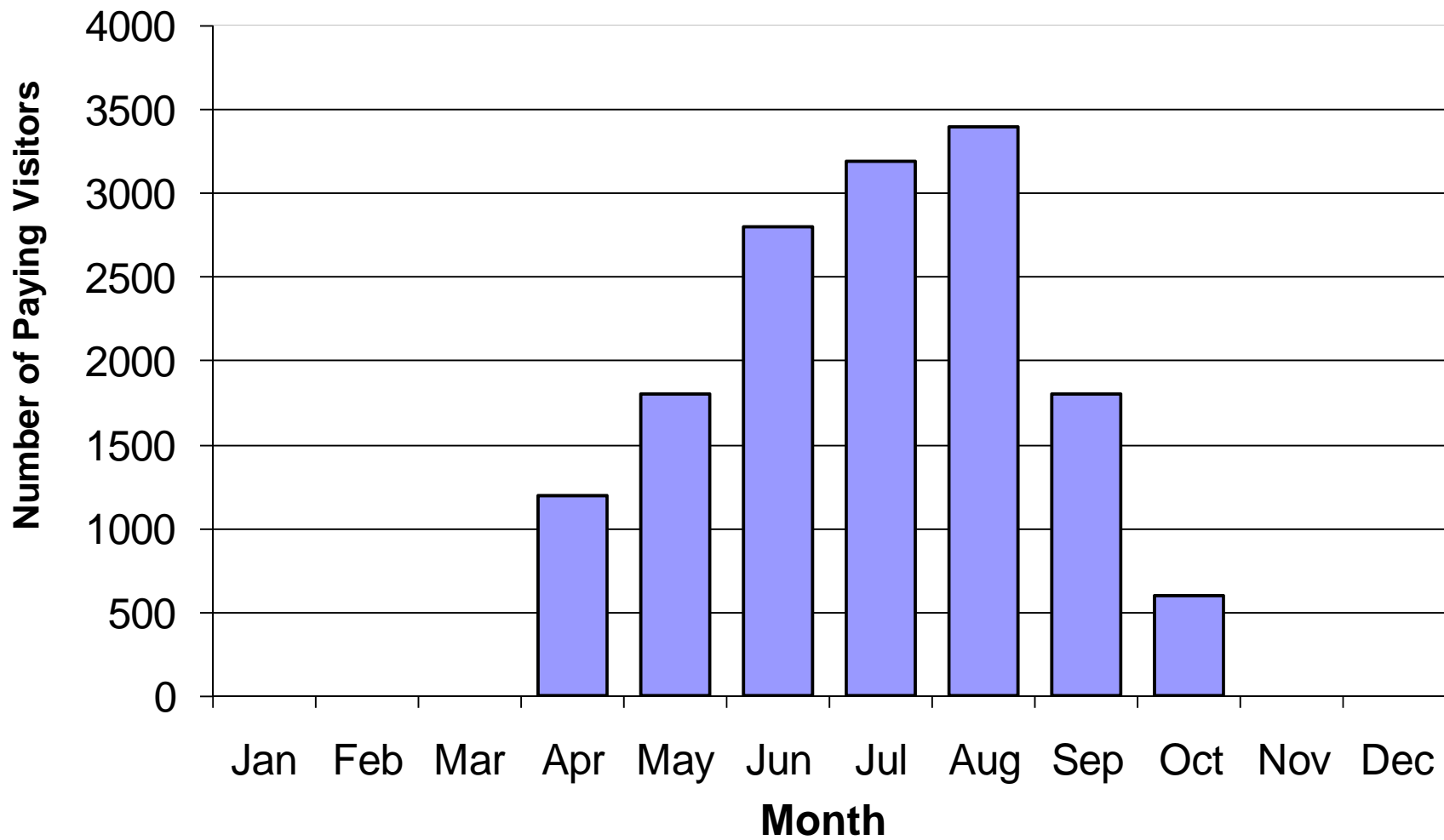
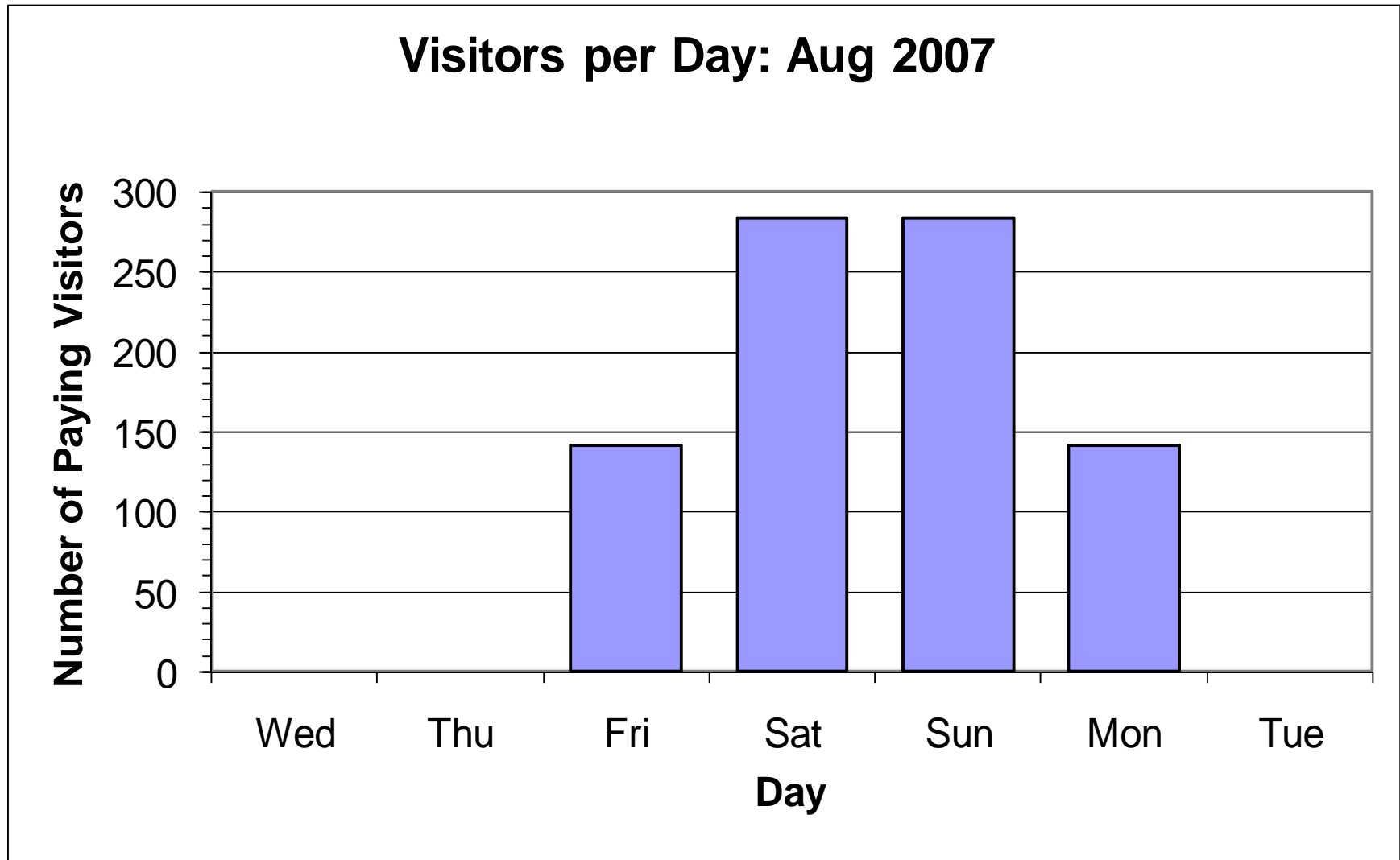


Exhibit 11.3



### Farm Visitor "in-process" Inventory: Saturdays and Sundays in August 2007

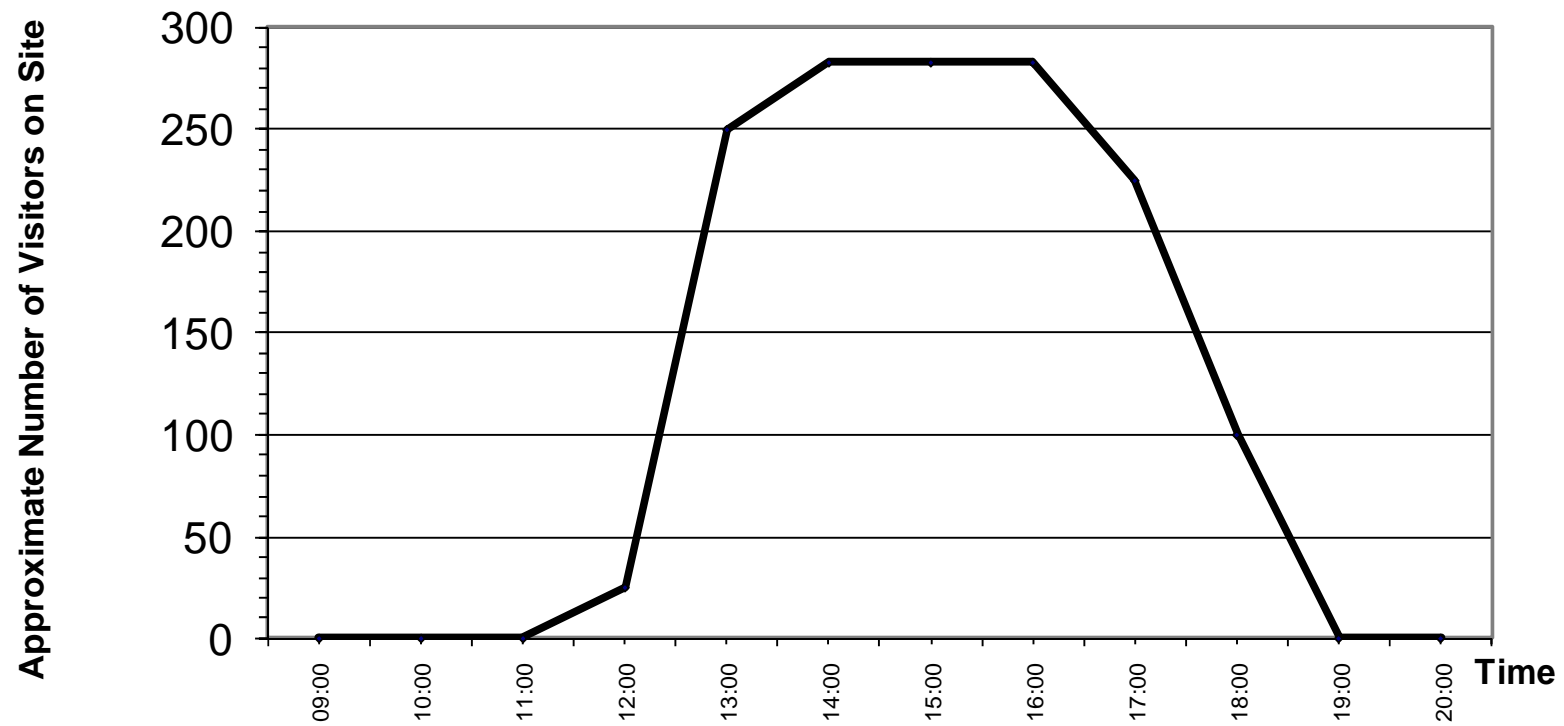


Exhibit 11.4

## Total Sales and Forecast

	Litres	
Sales to	2007	2008 (forecast)
Retail shops	50,000	43,333
Farm shop	13,500	20,000
Total	63,500	63,333



# Inventory Management

## 9.1 Introduction

This is a relatively quantitative chapter. Partly this is because the various quantitative models of stock control have within them the assumptions upon which we base most inventory management. Therefore working through the mathematics of stock control we are implicitly establishing the key cost drivers and principles of the subject. The other reason for taking a more quantitative approach is that it is traditional. Most textbooks in this area are expected to have the inventory models covered in this way. Perhaps this is a mistake we all make as teachers. It may be convenient to teach the mathematics of stock control, but how relevant is it? This is a question we can only decide individually. Our approach is to limit the use of mathematical models. So for example, we hardly ever go beyond establishing the basic economic order quantity (EOQ) formula. The important point is to examine the assumptions within the models. This allows one to look at the various cost elements affected by inventory, examine issues such as cost of capital, look at how (for example) the cost of keeping inventory might affect stock control decisions, and so on.

### *Key teaching objectives*

- To define what we mean by inventory.
- To identify why inventory occurs in different types of operation and in supply chains generally.
- To establish the underlying assumptions and cost drivers of inventory through the use of order quantity formulae.
- To establish some of the practical difficulties of managing inventories in a dynamic sense.

## 9.2 Exercises/discussion points

There are many cases and exercises which one could use to introduce operations management. You might like to try some of these ideas, all of which we have used.

-

- **Exercise** - An exercise which we have found useful is to set the class the task of investigating how much money is tied up in stocks in various companies. The easy availability of company accounts on the internet now makes this task much more feasible. Get them to compare different types of company and thus identify the kinds of organisation where stock control is particularly important from a financial point of view.
- **Teaching tip** Lead a discussion on how companies which have very large inventory costs manage. Examples such as gold processors and supermarkets are useful here. In some ways both of them have stock costs which are so large that they need to be treated separately from the day-to-day operations management costs which the operation incurs. For example, in many gold processors and precious metals companies the value of the gold etc. does not even appear on the company's financial statements. It would dwarf everything else. It is treated as belonging to a customer. The company then performs a service on the customer surrogate (the gold).
- **Exercise** - The dynamics of stock control lend themselves to very simple classroom based games. For example, give a forecast to the class of how many goods are likely to be sold period by period. Also indicate the costs of placing an order and holding stock. Devise a simple form which allows the class (in groups) to make ordering decisions and keep track of their stock levels and costs. Then (fairly rapidly) simulate a period of time, usually 20 or 30 periods, by taking values around the forecast for each period (but not exactly as forecast of course). The winner is the group with the lowest costs and the highest customer service. (It may be necessary to put an artificial cost on stock-outs to make evaluation simpler.)

### 9.3 Suggested questions and answers to 'operations in practice' and short cases

#### The UK's National Blood Service

Suggested questions.....

1. What are the factors which constitute inventory holding costs, order costs, and stock-out costs in a National Blood Service?
2. What makes this particular inventory planning and control example so complex?
3. How might the efficiency with which a National Blood Service controls its inventory affect its ability to collect blood?

**What are the factors which constitute inventory holding costs, order costs, and stock-out costs in a National Blood Service?**

**Holding costs** – will include costs associated with storage (such as freezing) and any wastage because of out-dated or mismatched blood types.

**Order costs** – include the cost of collecting the blood in the first place, both on a regular basis and on an emergency basis when blood is needed at short notice.

**Stock-out costs** – these may be relatively small if a substitute blood group can be used, higher if blood has to be obtained from a neighbouring area because it is unavailable locally, or very high indeed if a lack of blood leads to permanent patient damage or even death.

**What makes this particular inventory planning and control example so complex?**

First, the cost of failure is very high as indicated above. Second, both demand and supply are uncertain. As indicated in the example, local accidents could increase the usage of blood many times over. But also collection is not perfectly predictable. Bad weather, holiday periods and so on, can all affect how much blood can be collected. Third, the blood needs to be stored in very precise conditions and can be wasted if not used before its use-by-date. Fourth, there are many different 'products' under the general classification of 'blood'. The different blood types plus the different blood derivatives will all have to be managed separately.

**How might the efficiency with which a National Blood Service controls its inventory affect its ability to collect blood?**

An inefficient blood service would not only be costly but also would be wasteful of blood. Both these could affect its ability to collect blood. If it is spending money needlessly on the storage and management of blood it has less money to advertise for blood donors and collect blood in mobile centres and so on. Perhaps more significantly, if large amounts of blood are being wasted, public donors are unlikely to be as motivated to come along and give blood freely.

**Howard Smith Paper Group**

Suggested question....

1. Why has the Howard Smith Paper Group invested so much capital in automating its inventory storage and control capabilities?



### **Why has the Howard Smith Paper Group invested so much capital in automating its inventory storage and control capabilities?**

The answer to this is similar for all types of investment in all types of operation, namely that the company's ability to compete in its markets depends on an effective operations function. In turn, an effective operations function depends on appropriate levels of design, planning and control, and improvement. This, in turn, depends on investment. The technologies that the Howard Smith Paper Group has invested in are there to give it better performance in terms of quality, speed, dependability, flexibility and cost. Automated warehouses and computer-based control systems help to ensure accuracy in fulfilling orders (quality), the ability to respond quickly to customer orders (speed), the ability to supply in a consistent and reliable manner (dependability), the ability to cope with changes in demand levels and the mix and products supplied (flexibility), and to do all of these things with a low level of cost. Presumably the company's investments have enabled it to do all these things.

## **9.4 Further examples**

### **Croft Port**

Not all inventory is purely a source of cost. Some industries rely on it to add value. Oporto, a Portuguese city famous for Port wine is awash with inventory. While wines in the style of Port are produced around the world in several countries, including Australia and South Africa, only the product from Portugal may be labelled as Port. One of the famous Port brands is Croft Port which was founded in 1678. It owns one of the best wine growing estates in the Douro valley, Quinta da Roêda. When the grapes have been picked they are crushed at the wineries (in the Douro valley). They used to be crushed by treading by foot with a row of people holding on to each other and walking back and forth across the granite 'baths' filled with the grapes. Now mechanical methods are used. As the grapes are squashed fermentation begins as the natural sugars in the juice are converted into alcohol by micro-organisms (yeast) in the grapes. The grape skins are retained during crushing to ensure their colour and tannins are released into the wine. After a while the skins are allowed to float to the surface and the fermenting juice is drawn from underneath. It is then mixed with a neutral grape spirit (fortification) to raise the strength of the wine and also stop fermentation in order to preserve some of the natural grape sugars in the finished product. The wine is then stored and aged in barrels in the cool dark caves (cellars) in Vila Nova de Gaia to allow the wine to mellow and develop its flavours before being bottled. There are essentially two styles of Port, wood-aged and bottle-aged. Most Port wines are wood-aged in oak vats or casks for five or six years for full bodied wines or for 10-20 years for Tawny Ports. They are then bottled and ready to drink. The main type of bottle-aged Port is vintage

Port, the best and rarest of all Ports. This is made up of a selection of the very best grapes from the harvest of exceptional years. Although this Port is only stored in the oak barrels for two years it is then allowed to mature and age in the bottles for many years often decades.

### **Croft Port – Teaching note**

Suggested question.....

1. How could Croft Port reduce its inventory?

#### **How could Croft Port reduce its inventory?**

OK, so it's a trick question! The issue here is whether the port is really inventory or not. And the answer is that, while it is maturing, the port has value being added to it. In other words it's part of the process of production. Although it is seemingly being stored, it is not inventory at all. Therefore it would be a mistake to try and reduce inventory during this period. Of course, as soon as it reaches maturity and can be sold, it becomes inventory in the traditional sense.

### **Manor bakeries**

Inventory management is one of the most important operations management activities at Manor Bakeries, Europe's largest manufacturer of 'ambient' packaged cakes and pies. (Ambient means that they can be stored at room temperature). Its brands include Lyons and Mr. Kipling. Its fleet of vans routinely restocks the shelves of thousands of small retailers, and also distributes to major supermarkets, but here the re-ordering process is usually managed by the supermarket's own inventory management systems. Cakes are produced at four factories, on production lines, some of which are operated continuously. Although considerable effort is made to forecast sales accurately, there is always uncertainty. Yet there are limits to how much inventory can be used to compensate for demand fluctuations because supermarkets require products to be on their shelves for most their shelf-life, allowing only a few days for Manor to transport, store, and deliver the products.

Input stocks of raw materials must also be carefully managed at each factory. Bulk ingredients such as flour and sugar are delivered to giant storage silos, but managing the hundreds of other ingredients (butter, nuts, dried fruits, pasteurized egg, etc) is more complex. Some of these are

not expensive, but are used in huge volumes, while others are very expensive but usage is small. Some ingredients have a short shelf-life and have to be stored in special conditions. Some are easily available, others are specially imported and are on long lead-times and fresh annual crops such as fruit can vary in quality and availability. Packaging is frequently changed to reflect new promotions and price changes. Yet running out of stock is serious. It can disrupt production schedules and lead to stock-outs of finished products, affecting both sales and customer relations. Inventory also occurs because of the way products are produced on the production lines. Although some products sell enough to warrant their own production lines, most lines have been designed to make a range of similar products. So products are made in batches, sufficient to last until the next production run.

Suggested questions....

1. What are the factors which constitute inventory holding costs, order costs, and stock-out costs at Manor Bakeries?
2. What makes its inventory planning and control so complex?

### **What are the factors which constitute inventory holding costs, order costs, and stock-out costs at Manor Bakeries?**

The planning and control of inventory at Manor Bakeries is obviously a critical part of the operations. For every one of the hundreds of products, a stock-out would result in lost sales and annoyed customers. On the other hand, excess inventory takes up space in the NDC, ties up working capital, and is 'aging', eroding its precious shelf-life and eventually making it too old to sell. However, the example also highlights a few of the less desirable aspects of inventory. It has to be financed as working capital, preventing this money being used for other purposes such as investment in new machinery. It must be stored in suitable conditions taking up valuable space which could be used more productively, and possibly needing significant capital investment in buildings, pallet storage racks, forklift trucks etc. Inventory requires systems and skilled people to plan and control it, and becomes older by the minute, deteriorating or even becoming unusable. It is this balance between the positive and negative aspects of inventory that is the subject of this chapter.

### **What makes its inventory planning and control so complex?**

Mainly it is because of a combination of variety, complexity and perishability.

Variety – Manor bakeries produce a wide variety of different cakes, in various sizes, and using various packaging. Some products may be seasonal, or packed in short-life 'special' packs such as 'buy-one-get-one-free' (BOGOFs) packs.

Complexity – Cakes, like many products have an inbuilt complexity because they cannot be produced without all their components (ingredients) being available and in good condition. A stock-out of even a very minor ingredient will hold up production.

Perishability – All the components (ingredients) used by Manor Bakeries are perishable; they have a limited life. Even packaging will become obsolete as designs change.

## **Trans-European Plastics**

Trans-European Plastics (TEP) is one of Europe's largest manufacturers of plastic household items. Its French factory makes a range of over 500 products that are sold to wholesalers and large retailers throughout Europe. The company dispatches orders within 24 hours of receipt of using an international carrier. All customers would expect to receive their requirements in full within one week. The manufacturing operation is based on batch production, employing 24 large injection-moulding machines. Weekly production schedules are prepared by the Planning and Control office, detailing the sequence of products (moulds and colours) to be used, the quantity required for each batch, and the anticipated timing of each production run. Mould changes ('set-ups') take on average three hours, at an estimated cost of 500 Euros per set-up.

Concerned about the declining delivery reliability, increased levels of finished goods inventory, and falling productivity (apparently resulting from 'split-batches' where only part of a planned production batch is produced to overcome immediate shortages), the CEO, Francis Lamouche, employed consultants to undertake a complete review of operations. On the 2nd January, a full physical inventory check was taken. A representative sample of 20 products from the range is shown in Table 12.7.

**Table 12.7 Details of a representative sample of 20 TEP products**

Product reference number*	Description	Unit manuf'g variable cost (Euro)	Last 12 mths' sales (000s)	Physical inventory 2 Jan (000s)	Re-order quantity (000s)	Standard moulding rate** (items/hour))
016GH	Storage bin large	2.40	10	0	5	240
033KN	Storage jar + lid	3.60	60	6	4	200
041GH	10 litre bucket	0.75	2200	360	600	300
062GD	Grecian-style pot	4.50	40	15	20	180
080BR	Bathroom mirror	7.50	5	6	5	250
101KN	1 litre jug	0.90	100	22	20	600
126KN	Pack (10) bag clips	0.45	200	80	50	2000
143BB	Baby bath	3.75	50	1	2	90
169BB	Baby potty	2.25	60	0	4	180
188BQ	Barbecue table	16.20	10	8	5	120
232GD	Garden bird bath	3.00	2	6	4	200
261GH	Broom head	1.20	60	22	20	400
288KN	Pack (10) clothes pegs	1.50	10	17	50	1000
302BQ	Barbecue salad fork	0.30	5	12	8	400
351GH	Storage bin small	1.50	25	1	6	300
382KN	Round mixing bowl	0.75	800	25	80	650
421KN	Pasta jar	3.00	1	3	5	220
444GH	Wall hook	0.75	200	86	60	3000
472GH	Dustbin + lid	9.00	300	3	10	180
506BR	Soap holder	1.20	10	9	20	400

\* The reference number uses the following codes for ranges:

BB = Babycare      BQ = Barbecue      BR = Bathroom  
GD = Garden      GH = General household      KN = Kitchen

\*\* Moulding rate is for the product as described (e.g. includes lids, or pack quantities).

Because of current high demand for many products, the backlog of work for planned stock replenishment currently averages two weeks, and so all factory orders must be planned at least that far in advance. The re-order quantities (see Table 12.7) had always been established by the Estimating Department at the time when each new product was designed and the manufacturing costs were established, based on Marketing's estimates of likely demand. Recently, however, to minimize the total cost of set-ups and to maximize capacity utilization, all products are planned for a *minimum* production run of 20 hours. The individual re-order levels have not been reviewed for several years, but were originally based on two weeks' average

sales at that time. About 20 per cent of the products are very seasonal (e.g. Garden Range), with peak demand from April to August. Storage bins sell particularly well from October to December. The European Marketing Manager summarized the current position, *“Our coverage of the market has never been so comprehensive; we are able to offer a full range of household plastics, which appeals to most European tastes. But we will not retain our newly developed markets unless we can give distributors confidence that we will supply all their orders within one week. Unfortunately, at the moment, many receive several deliveries for each order, spread over many weeks. This certainly increases their administrative and handling costs, and our haulage costs. And sometimes the shortfall is only some small, low-value items like clothes pegs.”*

The factory operates on three, seven hour shifts, Monday to Friday: 105 hours per week, for 50 weeks per year. Regular overtime, typically 15 hours on a Saturday, has been worked most of the last year. Sunday is never used for production, allowing access to machines for routine and major overhauls. Machines are laid out in groups so that each operator can be kept highly utilized, attending to at least four machines. Any product can be made on any machine. Pierre Dumas, the production manager, was concerned about storage space:

*‘At the moment our warehouse is full, with products stacked on the floor in every available corner, which makes it vulnerable to damage from passing forklifts and from double-handling. We have finally agreed to approve an extension (costing over one million Euros) to be constructed in June – September this year, which will replace contract warehousing and associated transport which is costing us about 5 per cent of the manufacturing costs of the stored items. The return on investment for this project is well above our current 8 per cent cost of capital. There is no viable alternative, because if we run out of space, production will have to stop for a time. Some of our products occupy very large volumes of rack space. However, in the meantime we have decided to review all the re-order quantities. They seem either to result in excessive stock or too little stock to provide the service required. Large items such as the Baby Bath (Item 143BB) could be looked at first. This is a good starting point because the product has*

*stable and non-seasonal demand. We estimate that it costs us around 20% of the manufacturing variable costs to store such items for one year.'*

### **Questions**

- 1 Why is TEP unable to deliver all its products reliably within the target of one week, and what effects might that have on the distributors?
- 2 Applying the EBQ model, what batch size would you recommend for this product? How long will each batch take to produce, and how many batches per year will be made? Should this model be applied to calculate the re-order quantity for all the products, and if not, why?
- 3 How would the EBQ change if the set-up costs were reduced by 50%, and the holding costs were re-assessed at 40%, taking account of the opportunity costs of capital at TEP?
- 4 What internal problems result from the current planning and control policies? In particular, analyse stock turns and availability (e.g. high and low levels)
- 5 Using Pareto analysis, categorize the products into Classes A,B,C, based on usage value. Would this approach be useful for categorizing and controlling stock levels of all the products at TEP?
- 6 What overall recommendations would you make to Francis Lamouche about the proposed investment in the warehouse extension?

### **Trans-European Plastics - teaching notes**

TEP makes a range of more than 500 plastic household items using batch injection moulding. The case highlights increasing problems with inventory shortages and declining service levels, at the same time that total inventory levels were at a high level. The company was even considering investing in a warehouse extension. This case allows students to explore the underlying reasons for this situation, and there is considerable numerical data which can be analysed.

This case provides an ideal introduction to the topic of inventory management, and is at a level to be of use on both undergraduate and Masters / MBA courses. Although describing a manufacturing situation, there are no technical issues to be understood, and the analysis would be little different in a retailing type of service. It provides sufficient information for the students to

prepare spreadsheets for ABC analysis and categorisation. This would be a good case for assessed work, but is too long and complex for a traditional examination.

### **Some notes on the Trans-European Plastics case**

#### **1. Why is TEP unable to deliver all its products reliably within the target of one week, and what effects might that have on the distributors?**

There are 24 machines working a standard (non-overtime) week of 105 hours. Thus there are 2520 machine hours available per week. There are 500+ SKUs, each taking 3 hours to set-up, and the *minimum* run length is 20 hours. Thus any batch takes at least 23 hours of machine time. The theoretical maximum number of SKUs per standard (non-overtime) week is thus  $2520 / 23 = 110$ . Thus, *on average*, each SKU could be made only every 4.5 weeks ( $500 / 110 = 4.54$ ) or even less frequently, because larger batches for popular items will occupy more machine time. This illustrates that it would be impossible to make all products within the one week delivery window, and the company must operate a make to stock (MTS) system, with inventory levels based on forecasts rather than actual orders.

The table of representative products shows 2 products out of 20 (10%) out of stock as at 2<sup>nd</sup> January. In addition, there are three products at very low inventory levels (Baby Bath, Storage Bin (small), and Dustbin and Lid), all of which have stocks of less than two weeks' usage. This indicates that stock levels for about 25% of the SKUs are low or zero, putting supply at risk.

Analysing the twenty products listed in Table 12.8, the moulding time per product varies greatly between SKUs, as calculated in Table 1 below. Of the 20 products in the sample, 6 only need to be made once a year, or less frequently. The average batch moulding time is actually 137 hours plus 3 hours set-up = 140 hours. Thus it is only possible to make  $2520 \text{ hours} / 140 \text{ hours per batch} = 18$  batches a week! *On average*, therefore, each of the 500 products can be made every  $500 / 18 \text{ weeks} = 27$  weeks. For the high volume products such as the 10 litre bucket, the annual moulding hours (7333) exceed the time available on one machine (120 hours max x 50 weeks = 6000 hours), and thus the machine must be dedicated to the product, with no set-ups. The extra demand above 6000 hours production must be satisfied using a second mould intermittently.

Table 1: Analysis of the representative sample of 20 TEP products



Product ref number	Description	Last 12 mths' sales (000s)	Standard moulding rate** items/hour	Re-order quantity (000s)	Re-order quantity moulding time (hours)	Annual Moulding (hours)	Therefore Approx # Batches per year
016GH	Storage bin large	10	240	5	21	42	2
033KN	Storage jar + lid	60	200	4	20	300	15
041GH	10 litre bucket	2200	300	600	2000	7333	4
062GD	Grecian-style pot	40	180	20	111	222	2
080BR	Bathroom mirror	5	250	5	20	20	1
101KN	1 litre jug	100	600	20	33	167	5
126KN	Pack (10) bag clips	200	2000	50	25	100	4
143BB	Baby bath	50	90	2	22	555	25
169BB	Baby potty	60	180	4	22	333	15
188BQ	Barbecue table	10	120	5	42	83	2
232GD	Garden bird bath	2	200	4	20	10	<1
261GH	Broom head	60	400	20	50	150	3
288KN	Pack (10) clothes pegs	10	1000	50	50	10	<<1
302BQ	Barbecue salad fork	5	400	8	20	13	<1
351GH	Storage bin small	25	300	6	20	83	4
382KN	Round mixing bowl	800	650	80	123	1231	10
421KN	Pasta jar	1	220	5	23	5	<1
444GH	Wall hook	200	3000	60	20	67	3
472GH	Dustbin + lid	300	180	10	56	1667	30
506BR	Soap holder	10	400	20	50	25	<1
	AVERAGE				137	620	

Thus the reasons for poor delivery performance are thus:

- The product range is 500 products (SKUs), with a very wide range of demand per SKU, but there are only 24 machines, so production of many items is extremely infrequent. This is exacerbated by the need to run each batch for at least 20 hours with a three hour set-up. Thus production has to be MTS, with forecast levels of demand for months ahead. During this long period of anticipation of demand, fluctuations in actual sales can lead to stock-outs or excess stock.

- The Reorder Levels are historic, based on the estimated demand rate, and originally representing two weeks' usage; these do not take account of current actual demand which could be greater or less than at the time they were established. Because there is now a two week backlog of moulding to replenish stocks, there is a high probability that stock-outs will occur before moulding has commenced. There is ample evidence in the Table 12.8 that this has occurred.
- Some of the products are seasonal: demand is higher than average at certain times. However, the system is not sensitive to this seasonality: the reorder levels do not change. The figures in Table 12.8 are as at January, which is a period of relatively LOW demand! Stock availability can only get worse when the factory becomes overloaded with seasonal demand in April – August.
- Delivery lead times are universally ex-stock, with delivery within one week by carrier. This gives no scope at all for last-minute stock replenishment. The only way to achieve this is to hold sufficient stocks of every item in the list. The company is already considering extending the warehouse to achieve this, but that will not be sufficient without providing more moulding capacity too. The investment is justified by the reduction in outsourced warehousing and transport, which suggests that the uplift in storage capacity may not be so great in practice.

The effects on distributors could be as follows

- Loss of confidence in TEP
- Loss of potential sales of products, particularly seasonal ones.
- Extra costs involved in their ordering and accounting systems (eg multiple deliveries against one order, complex reconciliation of statements).
- Extra time and costs involved in chasing deliveries.
- Possible resistance to ordering new items to the range, on the basis that they are already awaiting existing mature products!
- Need to hold more inventory 'just-in-case' TEP does not deliver. Space and money consideration.

**2. Applying the EBQ model, what batch size would you recommend for this product? How long will each batch take to produce, and how many batches per year will be made? Should this model be applied to calculate the re-order quantity for all the products, and if not, why?**

The critical data on the Baby Bath (143BB) is

- Demand Rate (D) = 50 000 per year
- Production Rate (P) = 90 per hour = 9450 per week (105 hours) = 472500 per year
- Unit variable cost = 3.75 Euro
- Annual unit holding cost ( $C_h$ ) =  $0.20 \times 3.75 = 0.75$  Euro
- Cost of set-up ( $C_o$ ) is stated as 500 Euro

The formula to be used is the EBQ

$$EBQ = \sqrt{\frac{2 C_o D}{C_h (1 - D/P)}}$$

Where:

$C_o$  = cost of ordering or of set-up

D = demand rate

P = production rate

$C_h$  = cost of holding one unit for a period of time

Applying the data:

$$EBQ = \sqrt{\frac{2 * 500 * 50000}{0.75 * (1 - 50000 / 472500)}}$$

$$= 8634$$

(This compares with current ROQ of 2000)

The moulding rate is 90 per hour, so 8634 represents about 96 hours of work, which is exactly 4 days of continuous 24 hour production (output 8600).

To achieve annual production of 50 000 baths, 5.2 batches of 8600 would have to be made per year, at a frequency of about every ten weeks, assuming no seasonality and steady demand.

This approach could be used for all non-seasonal products. However, it is based on a number of assumptions that must be valid for it to be of use:

- Demand is stable, and in particular non-seasonal. This will not be valid for the Garden and Barbecue ranges in particular
- The real cost of inventory is understood. In this case the company is proposing to construct a very expensive warehouse extension. If this is required simply to hold the total EBQ of the

company, one could argue that the opportunity cost of this capital, as well as the working capital of the inventory should be included in the holding cost percentage

- The validity of prescriptive models: there seems to be no emphasis on set-up reduction in TEP. The high set-up cost is the main reason for large EBQs, but also has had an effect on service levels, as discussed in Question 1.
- The EBQ should not be considered for very bulky items, such as storage boxes, which might fill up excessively large amounts of storage

**3. How would the EBQ change if the set-up costs were reduced by 50%, and the holding costs were re-assessed at 40%, taking account of the opportunity costs of capital at TEP?**

Students should note that the demand rate and production rate do not change. However, the cost of holding one unit DOUBLES, and the cost of the set-ups HALVES. Applying these changes to the EBQ formula changes the EBQ values of  $C_o$  and  $C_h$

$$EBQ = \sqrt{\frac{2 C_o D}{C_h (1 - D/P)}}$$

$$\text{Change in EBQ} = \sqrt{0.5 / 2}$$

$$= \sqrt{0.25}$$

$$= 0.5$$

Thus the EBQ becomes 4300, which is two days' production every five weeks or so.

**4. What internal problems result from the current planning and control policies? In particular, analyse stock turns and availability (eg high and low levels).**

Some of this has been answered in Q1, but a more detailed analysis is justified. With a ROP system, average inventory will be approximately half of the ROQ, ignoring buffer inventory which does not seem to exist for many products. Thus the stock turns can be estimated as shown in Table 2:

*Table 2. Stock Levels and Estimated Stock Turns*

Product reference number*	Description	A) Last 12 mths' sales (000s)	Physical inventory 2 Jan (000s)	Re-order quantity (000s)	B) Average Inventory (approx half of	Estimate of stock turn (A/B)

					ROQ, 000s)	
016GH	Storage bin large	10	0	5	2.5	4.0
033KN	Storage jar + lid	60	6	4	2.0	15.0
041GH	10 litre bucket	2200	360	600	300.0	7.3
062GD	Grecian-style pot	40	15	20	10.0	4.0
080BR	Bathroom mirror	5	6	5	2.5	2.0
101KN	1 litre jug	100	22	20	10.0	10.0
126KN	Pack (10) bag clips	200	80	50	25.0	8.0
143BB	Baby bath	50	1	2	1.0	50.0
169BB	Baby potty	60	0	4	2.0	15.0
188BQ	Barbecue table	10	8	5	2.5	4.0
232GD	Garden bird bath	2	6	4	2.0	1.0
261GH	Broom head	60	22	20	10.0	6.0
288KN	Pack (10) clothes pegs	10	17	50	25.0	0.4
302BQ	Barbecue salad fork	5	12	8	4.0	1.3
351GH	Storage bin small	25	1	6	3.0	8.3
382KN	Round mixing bowl	800	25	80	40.0	20.0
421KN	Pasta jar	1	3	5	2.5	0.4
444GH	Wall hook	200	86	60	30.0	6.7
472GH	Dustbin + lid	300	3	10	5.0	60.0
506BR	Soap holder	10	9	20	10.0	1.0

As discussed earlier in Q1: The shaded areas in the table show that 2 products out of 20 (10%) are out of stock as at 2<sup>nd</sup> January. In addition, there are three products at very low inventory levels (Baby Bath, Storage Bin (small), and Dustbin and Lid), all of which have stocks of less than two weeks' usage. This indicates that stock levels for about 25% of the SKUs are low or zero, putting supply at risk.

Conversely, 4 out of the 20 products have stock turn of 1.0 or less! This is tying up working capital and space.

This analysis suggests that control of inventory for nearly half the product range is unsatisfactory (too high or too low).

**5. Using Pareto analysis, categorise the products into Classes A,B,C, based on usage value. Would this approach be useful for categorising and controlling stock levels of all the products at TEP?**

Students will have to prepare a table (ideally in MS Excel) such as that shown in Table 3 below (actually shown here in Word Table format), to calculate all the Annual Usage Values.

*Table 3: Calculation of Usage Values*

<b>Product reference number*</b>	<b>Description</b>	<b>Unit manuf'g variable cost (Euro)</b>	<b>Last 12 mths' sales (000s)</b>	<b>Physical inventory 2 Jan (000s)</b>	<b>Re-order quantity (000s)</b>	<b>Usage value £000 (cost * sales)</b>
016GH	Storage bin large	2.40	10	0	5	24
033KN	Storage jar + lid	3.60	60	6	4	216
041GH	10 litre bucket	0.75	2200	360	600	1650
062GD	Grecian-style pot	4.50	40	15	20	180
080BR	Bathroom mirror	7.50	5	6	5	37
101KN	1 litre jug	0.90	100	22	20	90
126KN	Pack (10) bag clips	0.45	200	80	50	90
143BB	Baby bath	3.75	50	1	2	187
169BB	Baby potty	2.25	60	0	4	135
188BQ	Barbecue table	16.20	10	8	5	162
232GD	Garden bird bath	3.00	2	6	4	6
261GH	Broom head	1.20	60	22	20	72
288KN	Pack (10) clothes pegs	1.50	10	17	50	15
302BQ	Barbecue salad fork	0.30	5	12	8	2
351GH	Storage bin small	1.50	25	1	6	37
382KN	Round mixing bowl	0.75	800	25	80	600
421KN	Pasta jar	3.00	1	3	5	3
444GH	Wall hook	0.75	200	86	60	150
472GH	Dustbin + lid	9.00	300	3	10	2700
506BR	Soap holder	1.20	10	9	20	12

This can then be ranked by usage value, and cumulative usage value calculated, as shown in Table 4:

*Table 4: Ranked and Cumulated Usage Value*

Product reference number*	Description	Unit manuf'g variable cost (Euro)	Last 12 mths' sales (000s)	Physical inventory 2 Jan (000s)	Usage value £000 (cost * sales)	Cumulative Usage Value	% of Cum Usage Value	ABC Caty.
472GH	Dustbin + lid	9.00	300	3	2700	2700	42.4	A
041GH	10 litre bucket	0.75	2200	360	1650	4350	68.3	A
382KN	Round mixing bowl	0.75	800	25	600	4950	77.7	A
033KN	Storage jar + lid	3.60	60	6	216	5166	81.1	A
143BB	Baby bath	3.75	50	1	187	5353	84.1	B
062GD	Grecian-style pot	4.50	40	15	180	5533	86.9	B
188BQ	Barbecue table	16.20	10	8	162	5695	89.4	B
444GH	Wall hook	0.75	200	86	150	5845	91.8	B
169BB	Baby potty	2.25	60	0	135	5980	93.9	B
101KN	1 litre jug	0.90	100	22	90	6070	95.3	B
126KN	Pack (10) bag clips	0.45	200	80	90	6160	96.7	C
261GH	Broom head	1.20	60	22	72	6232	97.9	C
080BR	Bathroom mirror	7.50	5	6	37	6269	98.4	C
351GH	Storage bin small	1.50	25	1	37	6306	99.0	C
016GH	Storage bin large	2.40	10	0	24	6330	99.4	C
288KN	Pack (10) clothes pegs	1.50	10	17	15	6345	99.6	C
506BR	Soap holder	1.20	10	9	12	6357	99.8	C
232GD	Garden bird bath	3.00	2	6	6	6363	99.9	C
421KN	Pasta jar	3.00	1	3	3	6366	100.0	C
302BQ	Barbecue salad fork	0.30	5	12	2	6368	100.0	C

This illustrates that four 'A' items account for 81% of annual usage value. These items should be the focus of management's attention in respect of ensuring that forecasting is done thoroughly, and that inventory levels are controlled tightly without prejudice to service levels of 100%.

Conversely, the ten 'C' items account for very little (298 000 Euro) of the total annual costs (6.3 million Euro), so risk of stock-outs can be minimised by making batches which satisfy (say) at least three months' demand (i.e. costing around 75 000 Euro for the sample of ten C items). Thus EBQ may not be appropriate here, and low stock turns are acceptable. Simple two bin or Kanban arrangements could be used to ensure availability.

**6. What overall recommendations would you make to Francis Lamouche about the proposed investment in the warehouse extension?**

The earlier analyses indicate that inventory is very badly planned and managed. Before pursuing the development of the warehouse extension, Francis must be sure that better systems are in place to ensure that no large excesses of inventory exist, whilst service levels are improved. A summary of improvements required is as follows:

- Pareto Analysis to provide highly visible categorisation (ABC)
- Different re-ordering and forecasting requirements for each category
- Use of EBQ for high usage value items, establishing new ROQs
- Remove slow moving and obsolete stock from warehouse
- Monitor service levels by product category
- Delay warehouse extension decision



# Planning and Control

## 10.1 Introduction

This chapter tries to explain some of the more commonly used terms in planning and control such as scheduling, sequencing, etc. Sometimes we teach this chapter as a stand-alone lesson, but often we combine it with the material in other chapters. More than most topics it does benefit from a very practical approach. Students, especially those without much experience, find it difficult to understand the real complexity involved in planning and control. There is limited benefit in telling such students just how complex the process is. They will never fully understand until they have done it. Therefore it is worthwhile either devising exercises which enable them to experience the complexity, or alternatively, use a simple example to prompt discussion during which time extra layers of complexity can be introduced.

### *Key teaching objectives*

- To make clear the separate but related nature of planning and control.
- To distinguish planning and control from the design activities which have been treated hitherto.
- To emphasise the ubiquitous nature of the planning and control activity – all operations have to do it, but those in more turbulent environments find it more difficult than those in stable environments.

## 10.2 Exercises/discussion points

- **Exercise** - In-tray exercises can be useful in this topic. Set up a simple case where jobs have to be scheduled through four or five processes. Load some of the jobs onto the processes as decisions already made, and give the students a number of further jobs to schedule. This could be done in the form of a very simple Gantt chart using pieces of coloured paper. Periodically issue information to the student groups changing the priorities of jobs.

- **Teaching tip** - Discuss the nature of planning and control in very different operations. For example, contrast an electricity power station with a fast food restaurant and debate the nature of loading, sequencing, scheduling, planning and control, and so on.
- **Teaching tip** – The first two examples at the beginning of the chapter are useful in promoting debate. Try asking what Joanne has to do to be an effective resource planning and controller. Write these on the board in groups that relate to some model of the elements of planning and control systems. One that is not used in this book, but may nevertheless be useful, involves the following.
  - A customer interface that forms a two-way information link between the operation's activities and its customers
  - A supply interface that does the same thing for the operation's suppliers
  - A set of overlapping 'core' mechanisms that perform basic tasks such as loading, sequencing, scheduling, and monitoring and control
  - A decision mechanism involving both operations staff and information systems that makes or confirms planning and control decisions.
- Only then write the headings above the points. Explain what each means. And then ask the class what are the equivalent activities in the Air France case

### 10.3 Suggested questions and answers to 'operations in practice' and short cases

#### Joanne manages the schedule

Suggested questions...

1. What are the main activities of the planning and control system that Joanne manages?
2. How does Joanne attempt to meet the, sometimes conflicting, requirements of customers and the workshop as she manages the planning and control system?

#### What are the main activities of the planning and control system that Joanne manages?

Although there are many different ways to describe the activities of a planning and control system, there are a few vital activities. These are listed below.

*The system must interface with customers* - . The system must interface with both individual customers and the market more broadly. Depending on the business, these activities may include customer negotiation, order entry, demand forecasting, order promising, updating customers, keeping customer histories, post-delivery customer service and physical distribution. Joanne's system does this by distinguishing between different types of customer and treating them slightly differently. Urgent repairs are given priority, followed by regular servicing and internal work.

This customer interface is important because it defines the nature of the customer experience. This is why Joanne stresses the importance of managing customer expectations.

*The customer interface acts as a trigger function* – Booking a client in for a service or repair acts as a trigger for committing the operation's resources. These resources in this case are the technicians who carry out the repairs. In order to allocate jobs to technicians, Joanne uses a computer-based system that holds 'standard times' (although these are modified using her experience) to estimate the loading on each technician.

*The system interfaces with suppliers* - The timing and level of activities within the operation or process will have implications for the supply of products and services to the operation. In this case the most important 'supply' will be the spare parts that are needed. To some extent, the system attempts to predict these a day in advance by issuing a 'parts required' list.

*The system performs basic planning and control calculations* - Planning and control requires the reconciliation of supply and demand in terms of the level and timing of activities within an operation or process. For Joanne, this is largely automated within the computer system.

### **How does Joanne attempt to meet the, sometimes conflicting, requirements of customers and the workshop as she manages the planning and control system?**

For Joanne this involves attempting to maximize the utilization of her workshop resources whilst keeping customers satisfied. Partly, as previously mentioned, this involves managing customer expectations. But also, in addition, Joanne tries to build in as much flexibility as possible by getting customers to bring vehicles in as early as possible and collecting them as late as possible.

## **Operations control at Air France**

**1. What factors in the nature of demand are likely to affect the long-, medium- and short-term planning and control activities at Air France?**

Demand for Air France's services will fluctuate considerably although most of the fluctuation will be relatively predictable. Holiday times will obviously be busier than other times, but also the popularity of different routes will vary. Routes to skiing holiday resorts will be popular in the winter, those to beach resorts more popular in the summer and so on. The other significant factor concerning demand is the time of day at which services are required. Customers will not be happy at taking-off in the middle of the night (even if people living close to the airports didn't mind). Nor do they wish to arrive at their destination at inconvenient times. This loads both Air France's resources and the airport's resources more at some times during than at others. For example, a peak time at Charles de Gaulle airport is early in the morning when overnight flights from both east and west arrive.

**2. How is the supply of transformed and transforming resources likely to affect planning and control?**

Air France, like any other airline, has a limited number of planes, each of finite size. Scheduling its aircraft onto different routes so that their capacity can be fully utilised as well as scheduling maintenance periods is a particularly complex task. So, for example, a small aircraft may service a low volume route at a peak time in the morning and then be moved on to a high volume route during a quiet time in the middle of the day. Likewise air crew and ground crew have to be scheduled to match flights. Moving crew around the world is, in some ways, more complex than moving aircraft around the world because the crews cannot be 'run hot' like the aircraft can (running hot means operating all the time with the minimum breaks in between flights).

## **The hospital triage system**

**1. Why do you think that the triage system is effective in controlling operations in Accident and Emergency departments?**

Because it is quick and simple. It is a type of sequencing rule of the type the chapter described as a 'customer priority' sequencing rule. Also, there is no real alternative, using the degree of urgency to decide on the sequence of patients to be treated is obviously subjective but better than the alternatives. A 'first-come-first-served' rule could obviously put relatively minor cases before more urgent ones. Similarly, a rule based on 'who shouts loudest' would be even more unfair.

## **2. Are there any dangers in this approach?**

All sequencing rules are a trade-off between the complexity of the rule and the ease with which it is applied. Triage is a fast and simple rule where medical staff make a quick diagnosis to roughly categorise patients. This means that they can spend most of their time actually treating patients but it does mean that they may be mistaken in their initial diagnosis. The alternative would be to spend more time and effort performing this initial diagnosis which reduces the chances of mistakes but also reduces the time during which expensive and trained medical staff can be used actively to treat patients.

## **The life and times of a chicken salad sandwich**

### **1. The company who make the chicken sandwiches described here are considering buying pre-sliced tomatoes and cucumbers with a shelf life of only one day. What do you think might be the advantages and disadvantages of doing this?**

The advantage would seem to be that buying the vegetables this way takes out some activity from the 'sandwich filling preparation' process. Presumably the companies who receive and pack tomatoes and cucumbers will find it relatively easy to slice them and pack them in sliced form. Such companies will be handling large quantities of tomatoes and cucumbers whereas each sandwich factory is handling relatively smaller quantities. This could mean that the extra costs to the tomato and cucumber packers are less than the savings made by the sandwich company in being able to omit this stage in the production process. The shorter shelf life however is a significant disadvantage. Whereas tomatoes and cucumbers can normally be kept for three days in their whole form, sliced they only keep for one day. This makes the risk of the items 'out dating' higher than when they can be kept for three days. Unless the sandwich makers' forecasts are relatively accurate, this may be a significant disadvantage.

### **2. Why do you think production takes places overnight?**

Simply, to reduce the time between making the sandwich and it being put on display in the shop or supermarket. This means that the 'shelf life' in the shop or supermarket is maximised, albeit at the expense of higher labour costs for the night shift.

## **10.4 Further examples**

### **The WIZARD system at Avis**

It is possible to rent cars at almost every major airport and city centre in the world, and there is invariably intense competition to attract and keep customers. Since the hire companies all offer similar ranges of relatively new vehicles, and the reliability of these cars is taken for granted by most customers, competition is generally on service and/or price. The most critical service factor is the availability of the desired category (size and specification) of car, and the speed with which all the hire contract paperwork can be completed, so that the customer is not unnecessarily delayed. This depends on the effectiveness of the hire company's planning and control system. One of the most important Avis sites in Belgium is the operation at Brussels National Airport at Zaventem, which deals predominantly with business customers, and hires out up to 200 cars on a busy day. Avis's advertisement, targeted at the business market, emphasizes its ability to process customers quickly and efficiently. The objective is to complete the transaction in less than two minutes and this is facilitated by Avis's well-developed computer system, known as WIZARD, which handles all reservations, preparation of hire contracts at the service desks, inventory management and invoicing systems. WIZARD is a globally integrated system, with over 15 000 terminals in Avis branches worldwide, allowing international reservations to be made with accuracy and certainty, and helping to maximize the utilization of vehicles throughout the network.

Regular customer surveys and analyses of actual demand patterns are carried out to determine the customers' preferences in terms of type and category of vehicles, providing a guide to the Belgian fleet composition, which is managed from the central 'clearing house' at Machelen. Because each of the Belgian branch offices has access to a pool of cars held at Machelen, their local buffer stock requirements can be minimized. The requirements for the movement of car inventory between branches and between countries is centralized in this way, allowing the branches to concentrate on the task of providing good customer service. Each regular business customer has a unique reference number in WIZARD, allowing reservations to be made and rental contracts to be completed quickly, with only three pieces of information: the customer's number, the type of car required, and the duration of the hire. This type of transaction is usually completed in under two minutes, after which the customer goes directly to the car park and collects the car.

Suggested questions....

- 1 What do you see as the main planning and control tasks of the Wizard system?
- 2 How would you evaluate the effectiveness of the planning and control activity at Avis?

**What do you see as the main planning and control tasks of the WIZARD system?**

The main task of the WIZARD system is to ensure that any part of the Avis network has enough of the right type of cars at any time to satisfy all of 'pre-booked' demand and a reasonable proportion of unexpected demand. In addition it must build in buffer stocks of cars and sufficient flexibility to cope with unplanned events such as car breakdown or a customer not returning a car in the right place or at the right time. Finally, an important part of the Avis WIZARD system will be its ability to know exactly which cars are where at any point in time and use the information about future demand to predict how many of which type of car will be in a particular location at any point in the future.

**How would you evaluate the effectiveness of the planning and control activity at Avis?**

Two major measures would be those concerned with customer service and car utilisation. In fact there is a trade-off between the two. The system could ensure very high levels of customer service in terms of car availability by planning to have large numbers of cars at every point in the network. The chances of a customer turning up unexpectedly and wanting to hire a car but being unable to would be very low and the consequences of not being able to cope with unexpected events such as breakdown would also be low. However, this would obviously mean low car utilisation and therefore high costs. Conversely, the system could minimise the number of cars at each part of the network, increase car utilisation substantially but at the cost of disappointing many customers. The effectiveness of the WIZARD system could be measured in how far it was able to overcome this trade-off between operating cost and availability.

- **Air traffic control: a world-class juggling act**

Air traffic controllers have one of the most stressful jobs in the world. They are responsible for the lives of thousands of passengers who fly every day in and out of the world's airports. Over the last 15 years, the number of planes in the sky has doubled, leading to congestion at many airports and putting air traffic controllers under increasing pressure. The controllers battle to maintain 'separation standards' that set the distance between planes as they land and take-off. Sheer volume pushes the air traffic controllers' skills to the limit. Jim Courtney, an air traffic controller at LaGuardia Airport in New York, says: *'There are half a dozen moments of sheer terror in each year when you wish you did something else for a living.'*

- **New York – the world's busiest airspace**

The busiest airspace in the world is above New York. Around 7500 planes arrive and depart each day at New York's three airports, John F. Kennedy, LaGuardia and Newark. The three airports form a triangle around New York and are just 15 miles from each other. This requires careful coordination of traffic patterns, approach and take-off routes, using predetermined

invisible corridors in the sky to keep the planes away from each other. If the wind changes, all three airports work together to change the flight paths.

Sophisticated technology fitted to most of the bigger planes creates a safety zone around the aircraft so that when two aircraft get near to each other their computers negotiate which is going to take action to avoid the other and then alerts the pilot who changes course. Smaller aircraft, without radar, rely upon vision and the notion of 'little plane, big sky'.

During its passage into or out of an airport, each plane will pass through the hands of about eight different controllers. The airspace is divided into sectors controlled by different teams of air traffic controllers. Tower controllers at each airport control planes landing and taking off together with ground controllers who manage the movement of the planes on the ground around the airport. The TRACON (Terminal Radar Approach Control) controllers oversee the surrounding airspace. Each New York air traffic controller handles about 100 landings and take-offs an hour, about one every 45 seconds.

- **TRACON controllers**

The 60 TRACON controllers manage different sectors of airspace, with planes being handed over from one controller to the next. Each controller handles about 15 planes at a time, yet they never see them. All they see is a blip on a two-dimensional radar screen, which shows their aircraft type, altitude, speed and destination. The aircraft, however, are in three-dimensional airspace, flying at different altitudes and in various directions. The job of the approach controllers is to funnel planes from different directions into an orderly queue before handing each one over to the tower controllers for landing.

- **Tower controllers**

The tower controllers are responsible for coordinating landing and taking off. Newark is New York's busiest airport. During the early morning rush periods, there can be 40 planes an hour coming into land, with about 60 wanting to take-off. As a result there can be queues of up to 25 planes waiting to depart.

At LaGuardia, there are two runways that cross each other, one used for take-off and the other for landing. At peak times, air traffic controllers have to 'shoot the gap' – to get planes to take off in between the stream of landing aircraft, sometimes less than 60 seconds apart. Allowing planes to start their take-off as other planes are landing, using 'anticipated separation', keeps traffic moving and helps deal with increasing volumes of traffic. At peak times, controllers have to shoot the gap 80 times an hour.

Most airports handle a mixture of large and small planes, and tower controllers need to be able to calculate safe take-off intervals in an instant. They have to take into account aircraft type and capabilities in order to ensure that appropriate separations can be kept. The faster planes need to be given more space in front of them than the slower planes. Wake turbulence – mini-hurricanes which trail downstream of a plane's wing tips – is another major factor in



determining how closely planes can follow each other. The larger the plane and the slower the plane, the greater the turbulence.

Besides the usual 'large' planes, controllers have to manage the small aircraft, business helicopters, traffic spotter planes and the many sightseeing planes flying over Manhattan, or up the Hudson towards the Statue of Liberty. The tower controllers have to control the movement of over 2000 helicopters and light aircraft that fly through New York's airspace every day, being sure to keep them out of the airspace around each airport used by the arriving and departing aircraft.

- **Ground controllers**

As an aircraft lands, it is handed over to the ground controllers who are responsible for navigating it through the maze of interconnecting taxiways found at most international airports. Some airport layouts mean that planes, having landed, have to cross over the runway where other planes are taking off in order to get to the terminal. All this needs careful coordination by the ground controllers.

Some pilots may be unfamiliar with airport layouts and need careful coaxing. Worse still is poor visibility, fog or low cloud. At Kennedy airport, the ground radar does not show aircraft type, so the controllers have to rely upon memory and constant checking of aircraft position by radio to ensure they know where each aircraft is at any time.

- **Stress**

Dealing continually with so many aircraft movements means that controllers have but a split second to analyze and react to every situation, yet they need to be right 100 per cent of the time. Any small error or lapse in concentration can have catastrophic consequences. They can't afford to lose track of a single aircraft, because it may stray into someone else's air space and into the path of another aircraft. If the computer projects that two planes are about to fly closer than three miles, the Conflict Alert buzzer sounds and the controllers have just seconds to make the right decision and then transmit it to the pilots. Sometimes problems arise in the planes themselves, such as an aircraft running short of fuel. Emergency landing procedures cover such eventualities. At Kennedy airport, they have about one such incident each day. As one controller remarked: *'It's like an enhanced video game, except you only have one life.'*

### **Questions**

- 1 What does 'planning and control' mean to air traffic controllers?
- 2 What are the differing problems faced by TRACON, tower and ground controllers?
- 3 What sequencing rules do you think the tower controllers use?

## **Air traffic control: a world-class juggling act – Teaching note**

*Note - The case describes three sets of controllers who are in charge of the incoming and outgoing aircraft in the New York triangle. This triangle is formed from the three airports of John F Kennedy, LaGuardia and Newark, within fifteen miles of each other. The problems of the controllers together with issues of volume and timing are emphasised.*

*This case exercise is best used as an introduction to control. In fact it is not a particularly representative example of planning and control in most operations. However it does have drama and it is useful to illustrate the consequences of losing control. Furthermore, it also illustrates the idea of coordinating three sequential operations – TRACON controllers planning and controlling the air space, tower controllers planning and controlling take-off and landing, and ground controllers planning and controlling movement on the ground.*

*This exercise may also be extended by asking students to speculate on other issues. For example:*

*How does technology help the planning and control task in this example?*

*What are the job design issues which you think need to be addressed by air traffic control?*

### **What does 'planning and control' mean to air traffic controllers?**

Planning – There are three elements to the planning task described in this case. The first concerns the drawing of the 'invisible corridors' in the sky through which the planes are channelled. Related to this is the planning of how these invisible corridors are changed to cope with different weather conditions. In effect, this is route planning, a task which is undertaken in any transportation operation. The second part of the planning activity involves setting out procedures for emergency situations, such as emergency landings. This will involve predetermined routines not only on what happens to the plane subject to the emergency, but also to the other traffic in the air space and on the ground during the emergency. The third part of planning will involve rough capacity planning. Airlines run to schedules and therefore it is possible to forecast the expected number of planes arriving in the air space at any particular time. In some ways this is similar to the MRP (see Chapter 14) planning approach. So, if an aircraft is due at a certain point in air space at a particular time it should be possible to forecast when that aircraft will become the responsibility of the tower controllers, when it will become the responsibility of the ground controllers and so on. Of course, this is in theory only. Contingencies will have to be built into the plan to account for variation in the actual arrival times of aircraft.

Control – Control in this case places particular emphasis on monitoring. In other words, knowing where all the aircraft are at any point in time. Any loss of information means loss of control. As with most control procedures, air traffic controllers will be comparing what should be happening (where the aircraft should be) against what is actually happening (where the aircraft actually is). The important issue here is that if a particular aircraft is not approaching according to plan it will have an impact on all the other aircraft in the air space at the time. The final part of control therefore means adjusting the instructions given to the aircraft in order to take account of each other's position or deviation from position.

#### **What are the differing problems faced by TRACON, tower and ground controllers?**

TRACON controllers – There will be two types of problem for this control activity. First, the aircraft must be kept apart while they are in a particular sector. This will involve closely monitoring the position, direction and speed of each aircraft and predicting their relative positions over time. In this the TRACON controllers are assisted by the computers which help to predict whether aircraft are getting dangerously close, or will become dangerously close. The second issue for TRACON controllers will concern the handovers between different sectors. It is necessary for one controller to have charge of all aircraft in his or her air space because it is the position of the aircraft relative to each other which is important. However, the consequence of doing this is that there must be a handover between sectors. This is potentially a major failure point. Any failure to understand that responsibility has been passed on, or loss of monitoring, could be disastrous here.

Tower controllers – The major problem for tower controllers is capacity. The major bottleneck in capacity for air journeys is the airport itself. It is the tower controllers who schedule and control the passage of planes into and out of the airport. This is why the tower controllers at LeGuardia have to 'shoot the gap'. Although this is intrinsically risky, it increases the capacity of the airport substantially. Another issue for tower controllers is the variation between aircraft. The gap between planes taking-off or landing is a function of size because of the wake turbulence. This is the equivalent to 'changeover times' in a factory. Just as changeover times for a machine will depend on what is being changed from and what is being changed to, so the gap between aircraft depends on the size of the two aircraft.

Ground controllers – Although ground control seems the least dangerous of the three areas, several accidents have been caused at airports by aircraft straying onto the runway. Ground control therefore is important from a safety point of view as well as from an efficiency point of view. To be efficient, ground controllers must move aircraft swiftly away from the runways so as

not to cause bottlenecks or interfere with other aircraft. Where the ground path cuts across runways, this is a particularly sensitive task.

#### **What sequencing rules do you think the tower controllers use?**

Probably the most common sequencing rule will be that of 'due date'. In other words, prioritising landing slots according to the aircraft schedules. However, this is probably only a rough guide for aircraft controllers. 'First in, first out' rules, or orderly queuing, is also likely to be a principle adopted by the controllers. However, overriding all these will be a variant on the 'customer priority' rule which emphasises safety. Any aircraft which is short of fuel or has an emergency on board will always be given priority irrespective of its due date or its position in the queue.

#### **Operations in action - SAP at Rolls Royce<sup>1</sup>**

Rolls Royce is one of the world's largest manufacturers of the gas turbines that are used to propel civil aircraft, military aircraft, ships, and in power generation as well as many other uses. They are exceptionally complex products, typically with around 25000 parts, and hundreds of assemblies and sub-assemblies, and their production is equally complex with over 600 external suppliers and thousands of work centres in many different locations. This makes planning a complex task, which is why Rolls Royce was one of the earliest users of computers to help with the task. Traditionally the company had developed its own software, however this had become increasingly expensive compared with buying off-the-shelf systems. It was also risky because customized and complex software could be difficult to update and often could not exchange or share data. So, the company decided to implement a standard 'Enterprise Resource Planning' (ERP) system from the market leading German SAP company. Because it was a 'commercial' off-the-shelf system it would force the company to adopt a standardised approach. Also it would fully integrate all the company's systems, and updates would be made available by SAP. Finally, the whole organisation would be able to use a single database, reducing duplication and errors. The database modules included product information, resource information (plant assets, capacities of machines, all human resource data, etc.), inventory, external suppliers, order processing information, and external sales.

Yet the company knew that many ERP implementations had been expensive disasters. *"We were determined to ensure that this did not happen in Rolls Royce,"* said Julian Goulder, who led the implementation. *"The project was too important to us; it was the largest single element within our strategic investment plan. So, we had a core technical team that led the design of the systems, and a large implementation team that was spread around the businesses. We always made sure that we communicated the changes throughout the company*

*and used extensive education, and training. We also phased the implementation to avoid any risky 'big-bang' approach. There was an extensive data 'clean up' to ensure accuracy and integrity of existing information, and all existing processes were reviewed and standardised. In fact, this implementation forced us to re-examine all of our processes, to make sure that they fitted the SAP system. Within operations we have already seen a significant reduction in inventory, improved customer service, and substantially improved business information and controls."*

## **SAP at Rolls Royce – Teaching note**

Suggested question....

1. What decisions did Rolls Royce take in adopting its ERP system?

### **What decisions did Rolls Royce take in adopting its ERP system?**

The decisions were:

- Buy 'off-the-shelf' software rather than develop its own software. (In-house development had become expensive compared with buying off-the-shelf systems. It was also risky because customized and complex software could be difficult to update and often could not exchange or share data.)
- Which 'standard system to buy? (They adopted the SAP Company's system. It encouraged them to adopt a standardised and integrated approach and updates would be made available by SAP. Most importantly, SAP is by far the largest supplier of such systems.)
- How to manage the implementation? (They had a core technical team leading the design of the systems, together with a cross-organisation implementation team.)
- How to communicate with the organisation through the implementation? (They communicated *all* changes throughout the company and combined communication with 'extensive education, and training'.
- How to time the implementation? (They phased the implementation to minimise risk.)

## **SAP and its partners**

The largest European software company, based in Walldorf, Germany, SAP's growth over the years has matched the popularity of the ERP systems which are still the foundation of its success. Founded by five former IBM engineers in 1972, SAP launched its ground-breaking SAP R/1 system one year later. This was followed by SAP R/2 in 1979 and R/3 in 1992. In 1999 SAP anticipated the influence of the internet on network integration with its 'mySAP.com'

product. Now customers in more than 120 countries run SAP 'business software' applications. These range, as the Company phrases it, from distinct solutions addressing the needs of small businesses and midsize companies to suite offerings for global organizations. SAP defines 'business software' as comprising enterprise resource planning and related applications such as supply chain management, customer relationship management, product life-cycle management, and supplier relationship management.

SAP is well known for developing a network of 'business partners' to develop new products, sell its 'solutions', implement them into customers' operations, provide service, educate end users, and several other activities. There are various categories of partnerships.

**Global Alliances** - SAP global alliance partners are themselves global leaders and are therefore strategic partners with significant global presence. Membership is by invitation only.

**Original Equipment Manufacturers (OEM)** - This is for independent software vendors who integrate SAP technologies with their own products. OEM partners may add on, bundle, host, or embed SAP software.

**Solution Providers** - These partners offer customized solutions (a combination business, technical, or application expertise) that include SAP software.

**Complementary Technology Partners** - These partners provide complete, technically verified turnkey (out-of-the-box) software solutions that extend and add value to SAP solutions.

**Volume Resellers** - These partners resell all or part of the SAP software portfolio and derive their primary revenue from license sales.

**Authorized Education** – Are partners authorized by SAP to provide official training and education services to ensure that customers' employees gain optimal training.

## **SAP and its partners – Teaching note**

Suggested question....

1. If you were managing SAP's strategic partner programme, how would you ensure their long-term collaboration?

**If you were managing SAP's strategic partner programme, how would you ensure their long term collaboration?**

In fact SAP see this issue as so important that they have devised an 'SAP Partner Charter'. Its main points include the following.

- **World-class partner program** – SAP is committed to providing a world-class partner program that builds mutual trust and understanding among SAP, our partners, and our mutual customers. SAP will develop and measure partnerships by following clearly defined key performance indicators (KPIs). SAP will invest in and continually enhance the program to ensure maximum success for the partnerships and joint business.

- **Partner support** – SAP is committed to providing appropriate levels of support and resources, based on partner commitment, to enable partners to drive joint success. SAP will invest in partnership management resources in key areas such as business development, solution development, and field engagement.
- **Constant communication** – SAP is committed to promoting a clear understanding of its internal business processes. SAP will optimize partner access to our engineering, marketing, and field sales resources.
- **Training and certification** – SAP will provide partners with world-class training and certification programs to help them develop solutions that deliver value to customers. SAP will engage with partners early in the development process.
- **Clear engagement guidelines** – SAP is committed to developing and continually enhancing clear field engagement guidelines for both SAP and partner sales and consulting. SAP will work with partners to identify the solutions and customers we will pursue together, and those we will pursue separately.
- **Increased customer satisfaction** – SAP is committed to ensuring high levels of customer satisfaction by providing partners with the information and resources they need to deliver solutions and services that add value.
- **Lead generation** – SAP is committed to investing in lead-generation programs to promote the success of key strategic partners. SAP will pursue marketing opportunities to establish SAP and our partners as trusted advisors and ensure that solutions based on SAP technology are the first choice among customers.
- **Revenue enhancement** – SAP is committed to working with key strategic partners in targeted markets to increase mutual revenue, market share, and profitability. SAP will work with partners to develop joint business plans and go-to-market strategies that leverage our combined strengths.

**Why do you think that integrating an ERP system with those of suppliers and customers is so difficult?**

For two reasons. First, assuming that suppliers' and customers' ERP systems are relatively stable, they will all have marginal differences that have been built into the systems to make them appropriate for each individual business. Furthermore, they are unlikely all to have software supplied by the same company. SAP may be the largest company supplying ERP software, but there are many others. Also, each individual ERP system will be of a different level of sophistication. Some companies may have relatively old systems whereas others state-of-the-art systems. The software that manages the interface between these systems can be extremely complex and expensive. Second, the assumption that each company's ERP systems are stable is rarely the case in practice. As the sandwich company admits, because companies

are implementing their own new systems, integrating with a network of companies is like trying to hit a moving target. Therefore, integration must cope with the future plans for systems investment of all companies in the network and be sufficiently flexible to cope with at least some of the changes not yet planned.

### **What a waste!**

Not only can ERP implementation go wrong, even when undertaken by experienced professionals, sometimes it can end up in the law courts. Waste Management, Inc. is the leading provider of waste and environmental services in North America. In 2008 it announced that it was suing SAP (see earlier short case) over the failure of an ERP implementation. Waste Management said that it was seeking the recovery of more than \$100 million in project expenses as well as "the savings and benefits that the SAP software was promised to deliver to Waste Management." It said that SAP promised that the software could be fully implemented throughout all of Waste Management within 18 months, and that its software was an 'out-of-the-box' solution that would meet Waste Management's needs without any customization or enhancements,"

Waste Management signed a sales pact with SAP in October, 2005, but according to Waste Management, "Almost immediately following execution of the agreements, the SAP implementation team discovered significant 'gaps' between the software's functionality and Waste Management's business requirements. Waste Management has discovered that these gaps were already known to the product development team in Germany even before the SLA (service level agreement) was signed." But members of SAP's implementation team had reportedly blamed Waste Management for the functional gaps and had submitted change orders requiring that Waste Management pay for fixing them.

### **What a waste! – Teaching note**

Suggested questions....

1. Why did things go wrong with the relationship between SAP and Waste Management?

#### **Why did things go wrong with the relationship between SAP and Waste Management?**

Usually failures of large-scale IT systems like ERP are not clear cut. Many things can go wrong. Often vendors and the customers share at least some of the blame.

<http://i.zdnet.com/blogs/wmi.png> In this case the issue seems to be about what promises were made by SAP. According to Waste Management, SAP said it could offer a 'ready-made' and appropriate ERP system with no customization. The problem was that Waste Management was a large and complex company that has grown through acquisition and therefore has many old systems.



Maybe SAP promised too much in trying to secure the Waste Management business. Maybe Waste Management was negligent in assuming any system could be truly 'ready to use'. Certainly a pilot implementation could have exposed some of the subsequent problems.

# Lean operations and JIT

## 11.1 Introduction

Again, this is a topic with an important, but not always obvious, message. This underlying message concerns the link between an organisation's general 'approach' to how it thinks about operations management and what it actually does in practice. In teaching lean it is relatively easy to make this linkage. In other words, a company's philosophy of operations (if it has one) really does have an impact on what it does. If it has a high tolerance of in-process inventory, it will find it difficult to identify where improvement should be taking place. If it does not value the contribution which everyone throughout the operation can make to improvement, it will never release the full potential within its workforce. If it values high utilisation above fast throughput time, it will not understand the real underlying costs of its operations processes. This is an important message and fortunately there are plenty of opportunities whilst teaching lean to continually reinforce this message.

### *Key teaching objectives*

- To distinguish between the different contributions of JIT to operations management generally (it is a philosophy, it is a set of techniques, it is a way of planning and controlling movement through processes).
- To get students to understand the benefits of low between-stage inventory in spite of its counterintuitive feel.
- To link in JIT to the topics covered in other areas of the subject.
- To explain some of the criticisms of JIT.
- To demonstrate the fundamental difference between pull and push control.

## 11.2 Exercises/discussion points

There are many cases and exercises which one could use to introduce operations management. You might like to try some of these ideas, all of which we have used.

- **Exercise** - Different games can be devised especially to demonstrate lean. Here are two ideas.
  1. Take a cheap and easily available product which students can easily disassemble and assemble as a mock assembly line. We use electrical plugs. These have to be of the type with enough bits inside them to make the total disassembly/assembly task into four or five stages. Equip the four or five 'volunteer' students with appropriate technology (screwdrivers) and set the process running. Initially allow as much inventory to build up as they wish (this is why a small product is useful). Take key measures over a three or

four minute period such as the number produced, the total throughput time, the amount space of used, the total inventory in the system, and so on. Then run the game again, this time with 'kanban squares' of (say) one or two units only between the stages. Demonstrate how this increases throughput time and reduces inventory.

2. As an alternative to a simple product such as the domestic electrical plug, devise a product made with Lego bricks. This involves some initial outlay in order to purchase enough Lego to allow the game to run for some minutes. However, the advantage is that it is easier to balance the amount of work at each stage in the line and also one can allow 'design changes' and improvements in the system more easily.
- **Exercise** - With smaller groups such as smaller MBA classes or even executive classes, let everybody participate in these games in teams of five or six people. After the first one or two runs set them the challenge of improving the process. While they are doing this walk amongst them with a video camera and try and capture shots of them attempting to improve the process. It is not usually difficult to find examples of single individuals dominating discussion, groups splitting into two to do their own thing, poor communication, arguments and so on. The session can then be broadened out and illustrated using selected highlights from this video. This is especially useful for covering the continuous improvement and human issues in JIT.
  - **Teaching tip** - There is still in circulation an old video showing the above being done at Hewlett-Packard. The video dates from about 1984 and unfortunately the clothes worn by the people in the video make this obvious. Nevertheless, if you have fashion-indifferent students and can get hold the video it does demonstrate the principles well.
  - **Teaching tip** - Lead a discussion on how JIT principles could be used in a retail operation. Lead this discussion back into a discussion of supply chain and how the whole supply chain, from raw materials suppliers through to the retail operation, can be governed using JIT principles.

## 11.3 Suggested questions and answers to 'operations in practice' and short cases

### Toyota

Suggested question....

1. What elements of lean does the description of the Toyota Production System (TPS) mention in this description?

#### **What elements of lean does the description of the Toyota Production System (TPS) mention in this description?**

The Toyota Motor Company case mentions the following elements of lean (although it uses many more).

- Just-in-time – what it defines as the rapid and coordinated movement of parts throughout the production system and supply network to meet customer demand. But could also be taken as meaning doing exactly what is needed, when it is needed and where it is needed.

- Jidoka - described as 'humanizing the interface between operator and machine'. Also sometimes described as "automation with human intelligence" or 'Autonomation'. Jidoka can also refer to the practice of stopping a manual line or process when something goes amiss.
- Heijunka – meaning levelling and smoothing the flow of items, or more specifically the levelling of production by both volume and product mix. Using this system does not build products according to the actual flow of customer orders. Heijunka takes the total volume of orders in a period and levels them out so the same amount and mix are being made each day.
- Kanban – meaning signalling to the preceding process or activity, or a signaling system to trigger action that more parts are needed.
- Nagare – that is laying out processes to achieve smoother flow of parts throughout the production process (also called nagara sagyou, or a production system where seemingly unrelated tasks can be produced by the same operator simultaneously).

## UPDATE

Regarding the more recent problems at Toyota, the 'operations in practice' piece was written before the well reported problems. Nevertheless these problems actually give more discussion points and make the case even more useful. To help with this discussion here are excerpts from John Shook's Lean Management Web Column (Toyota Troubles: Fighting the Demons of Complexity). He is a frequent commentator on all things lean and here is interviewing Professor Takahiro Fujimoto, of the Manufacturing Management Research Centre, at the University of Tokyo.

**John Shook:** The rash of recalls and embarrassing public hearings in Washington represent an unprecedented crisis for Toyota. What is your take on what has led up to this state of affairs?

**Takahiro Fujimoto:** *The current series of problems represents a massive failure on the part of Toyota. And Toyota must take full responsibility for ending up where it is today. But the root causes of these problems are not easily identified. Many internal and external factors have combined in a complex mix. These include misjudgments by Toyota, and overconfidence in its own quality. The factors also include increasingly complex vehicle design, production increases and globalization, and the resulting explosive rise in the number of related problems. While some of these factors are specific to Toyota, others affect the industry as a whole. ....I have had ample opportunity to examine the company and do not believe that Toyota's guiding principles are the source of its troubles. Nevertheless, I do find that Toyota's operations have stumbled in both attentiveness and ability.*

*Moreover, I have observed an air of arrogance that may certainly have weakened Toyota in recent years. Yet it must be noted that Toyota faces the same huge challenge as any other company of its scale, in terms of product, market, and production complexity - all the challenges of globalization. The automobile companies of developed countries have been and will continue battling what we might call the demon of complexity - a long-distance obstacle course on which they are challenged to build their capabilities.*

*Toyota's great success of recent years put the company in a unique position, which led to some of its mistakes. The company was running too fast enjoying the tailwind of years of dramatic growth. When the financial boom in America generated increased demand for luxury cars, Toyota was able to meet that demand by tapping into its strong Japanese operations specializing in the mass production of complex products of high quality. Consequently, Toyota's volume of luxury cars exported to the U.S. rose rapidly, which generated unprecedentedly high profits. The company then invested that profit by rapidly expanding production volumes, and increasing the number of manufacturing facilities and product lines. As a result, Toyota found itself leading the world in production volume. As a trailblazer to develop environmentally-friendly vehicles, they also led the field in the "complexity race." However, when the U.S. boom turned to bust, Toyota's fortunes were reversed. The collapse of the American market for luxury cars, and a misguided period of investment into U.S. truck factories caused the red ink to start flowing. The rapid increase in the number of overseas factories and new models simply exceeded the amount of quality managers available. Observers suspect that the failure to evaluate and approve components designed by overseas suppliers lies behind the problem with the accelerator pedal.*

*Most important of all, Toyota's new position as global leader appears to have influenced leaders to lose sight of a fundamental way of thinking at the company. Toyota's thinking had always been "seek quality, and volume will follow". But the looming prize of becoming the world's number one automaker led some managers to replace the company's quality first policy with a "plan for volume and achieve volume" approach. The result was to chase volume and overextend on quality - a flaw that was amplified by the multiplying effects of increasingly complex designs and rapidly increasing volumes.*

## **Lean Hospitals**

In one of the increasing number of healthcare services to adopt lean principles, the Bolton hospitals National Health Service trust in the north of the UK, has reduced one of its hospital's mortality rate in one injury by more than a third. David Fillingham, chief executive of Bolton hospitals NHS trust said, *"We had far more people dying from fractured hips than should have been dying,"* then the trust greatly reduced its mortality rate for fractured neck of femur by re-designing the patient's stay in hospital to reduce or remove the waits between "useful activity". The mortality rate fell from 22.9% to 14.6%, which is the equivalent of 14 more patients surviving every six months. At the same time, average length of stay fell by a third from 34.6 days to 23.5 days.

The trust held five "rapid improvement events", involving employees from across the organisation who spent several days examining processes and identifying alternative ways how to improve them. Some management consultants were also used but strictly in an advisory role. In addition third-party experts were brought in. These included staff from the Royal Air Force, who has been applying lean principles to running aircraft carriers. The value of these outsiders

was not only their expertise, *"They asked all sorts of innocent, naïve questions,"* said Mr Fillingham, *"to which, often, no member of staff has an answer"*. Other lean-based improvement initiatives included examining the patient's whole experience from start to finish so that delays (some of which could prove fatal) could be removed on their journey to the operating theatre, radiology process were speeded up and unnecessary paperwork was eliminated. Cutting the length of stay and reducing process complications should also start to reduce costs, although Mr Fillingham says that it could take several years for the savings to become substantial. Not only that, but staff are also said to be helped by the changes because they can spend more time helping patients rather than doing non-value added activities.

Meanwhile at Salisbury district hospital in the south of the UK, lean principles have reduced delays in waiting for the results of tests from the ultrasound department. Waiting lists have been reduced from 12 weeks to between a 2 weeks and zero after an investigation showed that 67% of demand was coming from just 5% of possible ultrasound tests; abdominal, gynaecological and urological. So all work was steamed into routine "green" streams and complex "red" ones. This is like having different traffic lanes on a motorway dedicated to different types of traffic with fast cars in one lane and slow trucks in another. Mixing both types of work is like mixing fast cars and slow-moving trucks in all lanes. The department then concentrated on doing the routine "green" work more efficiently. For example, the initial date scan used to check the age of a foetus took only two minutes, so a series of five-minute slots were allocated just for these. *"The secret is to get the steady stream of high-volume, low-variety chugging down the ultrasound motorway,"* says Kate Hobson, who runs the department. Streaming routine work in this way has left more time to deal with the more complex jobs, yet staff are not overloaded. They are more likely to leave work on time and also believe that the department is doing a better job, all of which has improved morale says Kate Hobson, *"I think people feel their day is more structured now. It's not that madness, opening the doors and people coming at you."* Nor has this more disciplined approach impaired the department's ability to treat really urgent jobs. In fact it has stopped leaving space in its schedule for emergencies – the, now standard, short waiting time is usually sufficient for urgent jobs.,

## 11.4 Further examples

### **Perkins**

Perkins is one of the world's leaders in the design and manufacture of industrial diesel engines throughout the world. As well as reputation for ease of service along with low costs of maintenance and repair, Perkins must be able to provide a speedy and efficient service to its global network of distributors and dealers who keep parts and support close to the customer throughout the world. This is why throughput efficiency is so important to the company. "For us it is a tool that enables the value stream to be examined both inside Perkins and beyond it.

Working with our suppliers we can use measurement and the maps to identify areas of greatest potential improvement. In addition the map enables us to monitor the current state and understand the effect that specific improvement activities have on achieving our strategic goals of increased percentage of value added activities and reduced product lead time. We also wanted to train key Change Agents within our supply base and enable our suppliers to carry out this activity themselves and sustain year on year QCD improvements." (Jim Shaw, Supply Chain Development Manager)

Suggested questions.....

1. Sketch out what you think may be the stages in a value stream map for a company like Perkins.
2. What seem to be the advantages to Perkins of using this approach?

**Sketch out what you think may be the stages in a value stream map for a company like Perkins.**

First, Perkins must identify all the different value streams (product and component flows) that make up the finished product delivered to the customer. This may also include some service stream such as installation, servicing, etc. During this stage (as Perkins themselves make clear) it is important to understand the flow, not just within the Perkins factories, but also through suppliers, suppliers' suppliers, and so on. The second stage would be to identify the exact value added at each stage of the flow. Note this is different from the time taken for parts and components to flow between stages. The third stage would be to identify those parts of the value stream that appear to have the most potential for improvement. That is, where the difference between the time actually adding value and the time taken to flow between the stages is at its greatest.

**What seem to be the advantages to Perkins of using this approach?**

The obvious advantage is that it identifies those areas of greatest potential improvement. However, there are more advantages than this. It also develops an analytical approach to thinking about value within the company and its suppliers. Often, identifying that value added time is such a small part of throughput time is an important motivation when persuading people that improvement is possible. Some authorities claim that this 'educational' attribute of value stream mapping is one of its most beneficial effects.

## **Running hot**

Aircraft are expensive. Airlines try to use them round the clock because they can't make money from aircraft that are sitting idle on the ground. It is called 'running the aircraft hot' in the industry. For many smaller airlines, the biggest barrier to running hot is that their markets are not large enough to justify passenger flights during the day *and* night. So, in order to avoid aircraft being idle over night, they must be used in some other way. That was the motive behind Boeing's 737 'Quick Change' (QC) aircraft. With it, airlines have the flexibility to use it for passenger flights during the day and, with less than a one hour changeover (set-up) time, use it as a cargo airplane throughout the night. Boeing engineers designed frames that hold entire rows of seats that could smoothly glide on and off the aircraft allowing twelve seats to be rolled into place at once. When used for cargo, the seats are simply rolled out and replaced by special cargo containers designed to fit the curve of the fuselage and prevent damage to the interior.

Before reinstalling the seats the sidewalls are thoroughly cleaned so that, once the seats are in place, passengers cannot tell the difference between a QC aircraft and a normal 737.

Aloha Airlines, that serves Hawaii, particularly value the aircraft's flexibility. It allows them to provide frequent reliable services in both passenger and cargo markets. So the aircraft that has been carrying passengers around the islands during the day can be used to ship fresh supplies over night to the hotels that underpin the tourist industry. The flexibility also allows the airline to respond to emergencies. When Hurricane Iniki hit the islands the passenger market collapsed until damage could be repaired, but there was a huge increase in the amount of cargo traffic to repair the island's facilities.

Suggested questions....

1. If the changeover between 'passengers' and 'cargo' took 2 hours instead of 1 hour, how much impact do you think it would have on the usefulness of the aircraft?
2. For an aircraft that carries passengers all the time, what is the equivalent of set-up reduction? And why might it be important?

**If the changeover between 'passengers' and 'cargo' took two hours instead of one hour, how much impact do you think it would have on the usefulness of the aircraft?**

The impact would be twofold. First, there would be the additional costs of employing people for 2 x 2 hour changeovers as opposed to 2 x 1 hour changeovers. In other words, it would double the labour cost of achieving the flexibility. Second, it would cut effective capacity by at least 2 hours in 24. Given that part of the 24 hours is lost to loading and unloading passengers and/or cargo, refuelling, cleaning out, maintenance, and so on. The proportion of lost useful time is likely to be higher, say for example, 2 hours out of 15 or 16 useful hours. The combination of these two effects could very well significantly reduce the flexibility of the aircraft to a point where it was not worth the extra capital costs involved.

**For an aircraft that carries passengers all the time, what is the equivalent of set-up reduction? Why might it be important?**

For a passenger only aircraft, the equivalent of set up is the time taken to unload passengers at the end of a journey, clean out and restock the plane, and load up the next set of passengers. Low cost airlines in particular have been reducing this 'turn round' or set-up time, often to under half an hour. It is important because, like with the QC aircraft, it allows the aircraft to be utilised at a higher level. This means that they can carry more paying passengers which in turn means that the capital cost of the aircraft can be recouped faster.

## **A mobile parts hospital**

The idea was inspired by the Mobile Army Surgical Hospitals, or MASH units made famous in the film and television series of the same name. MASH units with their treatment rooms and operating theatres could be moved at short notice, so as to keep them close to the action where they were needed. In doing so they saved thousands of lives by offering fast access to suitable treatment. Also, soldiers with minor wounds could be treated and returned to service quickly. Now, that principle is being used to develop Mobile Parts Hospitals (MPH). These will be used to manufacture replacement parts for vehicles, tanks, and other weapons 'on demand', close to



the military field of operation. It is made possible through the development of a technique called stereo-lithography. This makes it possible to create solid objects from a digital specification in minutes rather than hours. A laser traces a pattern, layer by layer to create a solid object made of sintered powdered materials such as polymers or metals. Although still in its development stage the concept is being explored for application in other fields. Space stations, for example, cannot hold large workshops but could use small MPH-type units.

Suggested question...

1. Manufacturing parts through the process described above is many times more expensive than using conventional technologies in a factory. How would you go about evaluating the advantages and disadvantages of using MPH units instead of holding stocks of spare parts?

**Manufacturing parts through the process described above is many times more expensive than using conventional technologies in a factory. How would you go about evaluating the advantages and disadvantages of using MPH units instead of holding stocks of spare parts?**

The two issues here are speed and mobility, not cost. When the effective 'cost' of not having a part or a service is very high (such as in the mobile army surgical hospitals) the actual cost of providing that part or service often becomes almost insignificant. In the middle of a battle a broken down tank or truck is of little effective use. Considerations of cost at that moment do not rank very high. It is far more important to effect a repair quickly. This could be done by holding spare parts. However, especially in complex equipment, holding spare parts for every single part that could break would be difficult to achieve operationally. Even if (say) a spare parts kit could be organised it would need to be moved around with the piece of equipment it was supporting. This would inevitably reduce the mobility of that equipment, again, something that would render it less effective when in use.

### **Boys and Boden (B&B)**

*'There **must** be a better way of running this place!'* said Dean Hammond, recently recruited General Manager of B&B, as he finished a somewhat stressful conversation with a complaining customer, a large and loyal local building contractor.

*'We had six weeks to make their special staircase, and we are still late. I'll have to persuade one of the joiners to work overtime this weekend to get everything ready for Monday. We never seem to get complaints about quality ... our men always do an excellent job, but there is usually a big backlog of work, so how can we set priorities? We could do the most profitable work first, or the work for our biggest customers, or the jobs which are most behind. In practice, we try to satisfy everyone as best we can, but inevitably someone's order will be late. On paper, each job should be quite profitable, since we build in a big allowance for waste, and for timber defects. And we know the work content of almost any task we would have to do, and this is the basis of our estimating system. But, overall, the department isn't very profitable in comparison to our other operations, and most problems seem to end up with higher-than-anticipated costs and late deliveries!'*

Boys and Boden was a small, successful, privately owned timber and building materials merchant based in a small town. Over the years it had established its large Joinery Department,

which made doors, windows, staircases and other timber products, all to the exact special requirements of the customers, comprising numerous local and regional builders. In addition, the joiners would cut and prepare special orders of timber, such as non-standard sections, and special profiles including old designs of skirting board, sometimes at very short notice while the customers waited. Typically, for joinery items, the customer provided simple dimensioned sketches of the required products. These were then passed to the central Estimating/Quotations Department which, in conjunction with the Joinery Manager, calculated costs and prepared a written quotation which was faxed to the customer. This first stage was normally completed within two/three days, but on occasions could take a week or more. On receipt of an order, the original sketches and estimating details were passed back to the Joinery Manager across the yard, who roughly scheduled them into his plan, allocating them to individual craftsmen as they became available. Most of the joiners were capable of making any product, and enjoyed the wide variety of challenging work.

The Joinery Department appeared congested and somewhat untidy, but everyone believed that this was acceptable and normal for job shops, since there was no single flow route for materials. Whatever the design of the item being made, or the quantity, it was normal for the joiner to select the required timber from the storage building across the yard. The timber was then prepared using a planer/thicknesser. After that, the joiner would use a variety of processes, depending on the product. The timber could be machined into different cross-sectional shapes, cut into component lengths using a radial arm saw, joints formed by hand tools, or using a mortise/tenon machine, and so on. Finally the products would be glued and assembled, sanded smooth by hand or machine, and treated with preservatives, stains or varnishes if required. All the large and more expensive machines were grouped together by type (for example, saws) or were single pieces of equipment shared by all 10 or so joiners. Dean described what one might observe on a random visit to the Joinery Department:

*'One or two long staircases partly assembled, and crossing several work areas; large door frames on trestles being assembled; stacks of window components for a large contract being prepared and jointed, and so on. Off-cuts and wood shavings are scattered around the work area, but are cleared periodically when they get in the way or form a hazard. The joiners try to fit in with each other over the use of machinery, so are often working on several, part-finished items at once. Varnishing or staining has to be done when it's quiet – for example, evenings or weekends – or outside, to avoid dust contamination. Long off-cuts are stacked around the workshop, to be used up on any future occasion when these lengths or sections are required. However, it is often easier to take a new length of timber for each job, so the off-cuts do tend to build up over time. Unfortunately, everything I have described is getting worse as we get busier ... our sales are increasing so the system is getting more congested. The joiners are almost climbing over each other to do their work. Unfortunately, despite having more orders, the department has remained stubbornly unprofitable!*

*'Whilst analyzing in detail the lack of profit, we were horrified to find that, for the majority of orders, the actual times booked by the joiners exceeded the estimated times by up to 50 per cent. Sometimes this was attributable to new, inexperienced joiners. Although fully trained and qualified, they might lack the experience needed to complete a complex job in the time an estimator would expect, but there had been no feedback of this to the individual. We put one of these men on doors only; having overcome his initial reluctance, he has become our enthusiastic "door expert", and gets closely involved in quotations too, so he always does his work within the time estimates! However, the main time losses were found to be the result of general delays caused by congestion, interference, double handling and rework to rectify in-process damage. Moreover, we found that a joiner walked an average of nearly 5 km a day, usually carrying around bits of wood.*

*'When I did my operations management course on my MBA, the professor described the application of cellular manufacturing and JIT. From what I can remember, the idea seemed to be to get better flow, reducing the times and distances in the process, and thus achieving quicker throughput times. That is just what we need, but these concepts were explained in the context of high-volume, repetitive production of bicycles, whereas everything we make is "one-offs". However, although we do make a lot of different staircases, they all use roughly the same process steps:*

- 1 Cutting timber to width and length*
- 2 Sanding*
- 3 Machining*
- 4 Tenoning*
- 5 Manual assembly (glue and wedges).*

*'We have a lot of unused factory floor-space, so it would be relatively easy to set up a self-contained staircase cell. There is huge demand for special stairs in this region, but also a lot of competing small joinery businesses which can beat us on price and lead time. So we go to a lot of trouble quoting for stairs, but only win about 20 per cent of the business. If we got the cell idea to work, we could be more competitive on price and delivery, hence winning more orders. I know we will need a lot more volume to justify establishing the cell, so it's really a case of "chicken and egg"!'*

## **Boys and Boden – Teaching note**

### **Questions**

- 1** To what extent could (or should) Dean expect to apply the philosophies and techniques of JIT described in this chapter to the running of a staircase cell?
- 2** What are likely to be the main categories of costs and benefits in establishing the cell? Are there any non-financial benefits which should be taken into account?
- 3** At what stage, and how, should Dean sell his idea to the Joinery Manager and the workers?
- 4** How different would the cell work be to that in the main Joinery Department?
- 5** Should Dean differentiate the working environment by providing distinctive work-wear such as T-shirts and distinctively painted machines, in order to reinforce a cultural change?
- 6** What risks are associated with Dean's proposal?

### **Introduction**

Boys and Boden (B&B) is a small, independent building materials merchant which also undertakes the production of specialist, bespoke joinery items such as windows, doors, and staircases for local and regional customers. The newly appointed General Manager is considering whether the production of staircases would be improved by the creation of a "staircase cell" run on JIT principles. He learnt about these manufacturing approaches in his MBA Operations Management course, but in the context of high volume, repetitive manufacture; a very different environment from the "one-offs" situation at B&B. He aspires to not only improve delivery reliability, but also to regain control of costs, in order to restore profitability. It may also be possible to reduce the lead time (the case suggests that six weeks is needed for a special staircase), providing a further potential competitive advantage.

### **1. Can the philosophies and techniques of JIT be applied to the running of a staircase cell?**

Most students will be familiar with the general appearance and design of a typical staircase. The main components are:

- Strings (the two long sides of the flight)
- Treads (what you stand on)
- Risers (blank off the back of the treads)
- Newels (the posts that hold the handrails)
- Handrails (what you hold on to)
- Spindles (fill in the sides between the handrail and the strings)
- Other small parts such as wedges, joining blocks, infill pieces

Standard staircases are produced by specialist manufacturers in large quantities, using standard softwood timber, and at very low cost; they are made to stock, for immediate ex-stock delivery. In contrast, B&B make bespoke (special) staircases; the size, shape, and materials vary widely from order to order. Normally, no two staircases are exactly the same, although they often only differ in their dimensions or type of timber (e.g. oak, pine).

At the date of the case, B&B produced staircases in a general-purpose jobbing process, mixed with a wide range of other special products (doors, door frames, windows, etc). Staircases are usually large and cumbersome, getting in the way of the flow of other smaller products, (the case refers to "...joiners almost climbing over each other to do their work"). Although every qualified joiner (carpenter) had been trained to make a wide range of products, in practice, the less experienced ones were slow with unfamiliar work, simply because of the lack of repetition, and often failed to complete their work within the estimated times. In contrast, Dean (the General Manager) had already found that the "door expert" who specialised in special doors, kept to the estimated times. So it seems that the learning curve applies even in a jobbing environment.

Simple product structures which have routings with high repeatability are prime candidates for pull control. Staircases certainly meet both these criteria; the product structure is really only a simple three level BOM (timber, component, final assembly). The routing is standard for all stairs as described in the case.

The high product variety ensures that batch production would not be feasible, so the existing jobbing process is conducted one order at a time, akin to "batch of one". Because volumes are low, there has been little need for the division of labour; each joiner completes a whole staircase, but using the general-purpose machines (process layout) which are also needed for all other products. As Dean had noticed, this resulted in long process routes and interference between the processing of different products...i.e. waste.

Thus, although this is an unusual context for the application of JIT and cellular manufacturing, it does have many of the suggested pre-requisites. Looking at the philosophy of JIT,

*"JIT aims to meet demand instantaneously, with perfect quality and no waste"*

The fuller definition includes:

- Improving productivity
- Eliminating waste
- Delivery of the parts at the right quality, right time, right place
- Minimum use of facilities, equipment, materials, human resources
- Employee involvement
- Team work
- Simplification

These elements of the philosophy of JIT are generally consistent with Dean's requirements for the new system. But its commercial feasibility will be dependent on gaining sufficient extra volume for the cell to be viable as a team-based, operation with some division of labour, and with dedicated machinery and facilities. To an extent, therefore, it is a strategic investment with longer-term potential benefits.

The main objectives of the system would be to:

- increase capacity
- reduce lead time significantly (including the provision of quotations)
- maintain or improve quality
- reduce costs
- create a simplified work flow
- reduce / eliminate non-value-added activities
- develop a team culture for continuous improvement
- create a relatively autonomous business unit

Turning to the techniques of JIT, students will usually quickly appreciate that not all will apply to the proposed staircase cell. Taking each in turn:

JIT Technique	Applicability to Staircase Cell
Basic working practices	All elements can be applied usefully
Design for manufacture	Only a limited opportunity to use (details only)
Operations focus	Very relevant; basis of learning and competence
Small, simple machines	Yes, but only using existing types of machine
Layout and flow	Main basis of the development: cell-based layout
Total productive maintenance	Important, but not yet considered by Dean
Set-up reduction	Set-ups not considered as element of tasks
Total people involvement	Important element linked to the philosophy
Visibility	All very relevant and applicable

JIT supply	JIT component manufacture part of system
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In conclusion, most of the pre-requisites for implementation of the philosophies and techniques of JIT do (surprisingly) apply to the staircase cell. However, the main requirement to make it viable is extra volume, which could be generated by customers being increasingly satisfied with the price, quality and delivery performance of B&B's staircase operation.

## **2. Costs and benefits of establishing the cell, including non-financial.**

The case does not provide any actual costs or forecasts related to this development. In practice, only a few could realistically be determined in advance. In particular, the benefits were of a qualitative nature, underpinned by the strategic intent outlined above. The benefits are all potential ones, dependent on the successful management of the implementation.

	<b>COSTS</b>	<b>BENEFITS</b>
<b>FINANCIAL</b>	<ul style="list-style-type: none"> <li>• moving of equipment</li> <li>• duplicated equipment</li> <li>• training</li> <li>• dedicated support infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• increased productivity</li> <li>• reduced waste (rework, scrap)</li> <li>• increased orders / capacity</li> <li>• better flow for other products</li> </ul>
<b>NON-FINANCIAL</b>	<ul style="list-style-type: none"> <li>• disruption during change</li> <li>• managers distracted</li> <li>• reduced employee flexibility</li> <li>• personal (Dean) risk of failure</li> </ul>	<ul style="list-style-type: none"> <li>• vehicle for change</li> <li>• employee development</li> <li>• better identify market potential</li> <li>• continuous improvement</li> </ul>

### **3. How and when should Dean sell his idea to the Joinery Manager and to the workers?**

Students may wish to debate different views on this. Some will argue that it is best for Dean to have a fully worked-out and costed plan, which he would announce to the manager and workers sequentially on the same day, just prior to implementation. This would signal that no dissent was welcomed, and that the change was non-negotiable. It would only directly affect a few of the joiners, and those would be asked to volunteer for positions in the new cell.

Others would argue that this could provoke negative reactions from the manager and staff alike. Most would conclude that the manager should be involved in the feasibility analysis from quite early on. At the very least, there will be technical issues requiring early resolution (e.g. what type of machines should be used and/or purchased?). Others will argue that there are also similar advantages in involving the joiners from an early stage too, and this can help break down any resistance to change. Either way, most people will not have heard of cellular layout and will have distorted views about the meaning and applicability of JIT. These may be best addressed by an educational process (case studies, videos, games).

It is quite apparent that the introduction of the staircase cell will radically alter employees' working life and individual job designs. It is natural (and hence should be anticipated) that people will exaggerate the negative aspects, and underestimate the positive aspects. If these are not addressed, the cell is virtually destined to fail. In the end, Dean will have to use the very best of his interpersonal and analytical skills to win support at all levels. Early success in implementation will be vital.

### **4. Comparison of the work in the staircase cell and in the main Joinery Department.**

The main Joinery Department is a jobbing process, employing about ten skilled "jobbers", who have extremely wide skills, and a very high degree of autonomy to plan and control their work. They usually work independently, and are fully accountable for the quality of their outputs. Because they share key equipment and work space, they have to be adept at working out of sequence when certain machines are already in use. They are accustomed to carrying materials around the department (Dean recorded 5km per day!) and using the full range of equipment. They experience an enormous variety of products, materials and finishes. The link to estimating appears to be weak, since many jobs exceed their estimated times and costs.

In comparison, the staircase cell would employ a smaller number of joiners, working as a team. Their skills and experience could vary, since the potential division of labour would make it possible for at least one to concentrate on assembly and any other lower-skill tasks. The team

(rather than the individual) would have responsibility and relative autonomy to plan and control their work. There would be a fixed working sequence, fixed quality control procedures, and ample (excess) capacity at each work station. Material would flow in a fixed sequence, eliminating the need for many of the long carries. Task variety would be much lower, and the differences between orders often being simply variations in some dimensions and/or the type of timber. Estimated times would be closely linked to actual times, putting pressure on the team to improve output speed and productivity. Waste would be tightly controlled and improvement practices should be endemic.

This does not mean that the staircase cell would be unattractive to all the joiners. Some might see it as an advantage in terms of:

- Working in a team
- Good learning environment
- Developing deeper, specialised skills
- Existing work too complex and demanding

#### **5. Cultural change through differentiation of working environment and provision of work-wear.**

Students will be quick to recognise the symbolism of such approaches, and may feel that this will contribute to team identity and the clear formation of a separate identity. Many companies have found benefits in this way.

In the case of B&B, it is important that Dean ensures that the attitudes of all the joiners are favourable. It is quite common for new groups formed by management to be perceived as “management’s pets”, leading to tribal-style behaviour. This can include ostracising members of the tribe, name-calling, and even sabotage! The consequences can range from unhappiness to complete disruption.

If the whole workforce has “bought-in” to the change, these effects are less likely, and the use of symbolism may assist in the smooth operation of the cell.

#### **6. Risks associated with the proposal.**

Most of these have been covered in Question 2 above.

Perhaps the greatest risk is the failure to achieve the volume growth necessary to sustain a specialised, sizable cell.

In practice, this volume growth was achieved and the cell was a commercial success.



# Quality management

## 12.1 Introduction

Quality must be one of the more straightforward topics to teach. It is an intuitive issue for most students and there are many every day examples to draw on. However, statistical process control and acceptance sampling are both very important techniques but they can be dull. It is therefore useful to try to engage the students in the problems of managing quality and the four steps of quality planning and control to gain “buy-in” to the need to undertake and understand SPC and acceptance sampling.

We find it helpful to begin with defining quality characteristics. Using an example familiar to students, or from their experiences if post-experience students, ask them to define the quality characteristics of a product and a service. Discussion about their measurement, standards and how each should be controlled provides a great deal of rich debate.

### *Key teaching objectives*

- To demonstrate the importance of planning and controlling quality and experience the real problems faced in defining measuring and controlling quality characteristics.
- To provide hands-on experience of planning and controlling quality.
- To convince students of the importance of SPC and acceptance sampling.
- To introduce the four key ideas in the chapter:
  - Quality is consistent conformance to customers' expectations.
  - Poor quality as perceived by the customer results from one of or a combination of the four quality gaps.
  - Quality planning and control involves defining the quality characteristics, deciding how to measure each characteristic, setting quality standards and controlling against those standards.
  - SPC and acceptance sampling are important techniques for controlling quality.
- To provide students with an understanding of the TQM philosophy
- To demonstrate the real difficulties in achieving a TQM approach in organisations.

## 12.2 Exercises/discussion points

There are many cases and exercises which one could use to introduce operations management. You might like to try some of these ideas, all of which we have used.

- **Exercise** - It is particularly important that students come to understand the nature of variation in process performance and how it can affect quality. We have found the best way to do this is to devise games to demonstrate the choices that need to be made when dealing with variability. Fortunately it is not difficult to devise games of this sort. Here are two options.
- **Game 1** – Find some easily available product that contains pieces, supposedly of the same size. We use the small wooden blocks that are used in some children's building sets and games. Instruct groups of students to measure successive blocks using a micro measuring device (available at specialist and hardware stores). Get them to plot on an SPC chart the variation in the size of the blocks and from that calculate the central and control limits for mean and range.
- **Game 2** – Do something similar but select an Internet search site such as one that searches for cheap flights or hotel accommodation. Get the students to time the variance in response time and calculate limits as before. The advantage of this approach is that one can ask students to sample from the same site at different times to check whether the process is getting 'out of control'.
- **Game 3** – Use a short case study (an appropriate is shown at the end of this section) and ask the students to draw process charts. Then show them new data period by period and ask them to tell you when the process is out of control.
- **Teaching tip** - Use the Torres and Walkers illustrations (later) to identify quality characteristics. Ask students to select other products and services and define the characteristics and identify what they think will be the problems in achieving them.
- **Teaching tip** - After the Surgical Statistics example ask what other processes have to be 100% effective (but like all processes will never be so) e.g. nuclear power, surgery, water quality. Discuss how organisations try to minimize errors.
- **Teaching tip** - - Off-air video clips are particularly useful for teaching quality. Any short piece of video that simply shows an operation in practice. Retail organizations, hospitals, trucking companies, and so on are all shown frequently on air. Alternatively, select a 'business' programme that may have more in depth pieces. Show the video to students and ask them to define what quality would mean for such an operation.
- **Teaching tip** - - Organize a debate between groups of students, some of whom have to defend the proposition that 'McDonalds is a high quality organization'. And others who have to defend the proposition that '(a convenient local high-class restaurant) is a high quality organization'. Lead a debate about how the nature of quality differs between these two organizations.

## 12.3 Suggested questions and answers to 'operations in practice' and short cases

### Quality at the Four Seasons Canary Wharf

Suggested questions.....

1. The company has what it calls its Golden Rule; 'Do to others (guests and staff) as you would wish others to do to you'. Why is this important in ensuring high quality service?
2. What do you think the hotel's guests expect from their stay?
3. How do staff using their own initiative contribute to quality?

**The company has what it calls its Golden Rule; 'Do to others (guests and staff) as you would wish others to do to you'. Why is this important in ensuring high quality service?**

"It may be a simple rule, but it guides the whole organization's approach to quality" as the hotel manager says. The golden rule means treating guests with courtesy and intelligence. It also means that treating employees with humanity and respect encourages them to be equally sensitive to the needs and expectations of guests. It will also encourage a culture of caring. Certainly, it would be difficult to treat guests appropriately if, behind the scenes, there was constant friction and conflict.

**What do you think the hotel's guests expect from their stay?**

When guests come to a Four Seasons Hotel they need to have the assurance that they are going to get exceptional food, great service, anything they need from the 24 hour concierge service. Most importantly they will want the basics of the service to be faultless. This means a great night's sleep with no administrative errors or failures. Hotels in this category are not trading in service quality gimmicks. They focus on giving what they call 'the exceptional basics'. So they listen very carefully to their guests, give a lot of thought to their needs, and provide what they really need. For example, more than anything else, guests value a good night's sleep. So the hotel has invested time and research into obtaining the very best beds (they are made especially for them) and use the very finest cotton sheets. They have even developed a special fold at the end of the bed linen that means very tall people cannot push their feet out of the bottom of the bed. Also they spend an extraordinary amount of time on developing and maintaining their blackout curtains so that no unwanted light comes into the bedroom to interrupt your sleep. It's this attention to detail that counts in helping good night's sleep.

**How do staff using their own initiative contribute to quality?**

Four Seasons understand that there is nothing more important than their staff in achieving such high quality of service. The culture of the organization encourages creativity, initiative and attitude. (The most important of these is attitude. You can teach people the technical skills of the job but it is the attitude of our staff that sets them apart from any other hotel chains.)

An example of this..... *"We had a well-known person who was staying with us and speaking to a large gathering in the hotel in the evening. He was dressed casually and wearing bright green trainers. One of our staff escorted him to his room and carried his tuxedo for the evening's event. On arriving at the room the guest let out a sigh when he realized that he had forgotten to bring his formal shoes. Seeing that the guest's feet seemed to be around the same size as his own, our member of staff gave him his own shoes to wear. Not only was that guest delighted, he stood up at the event and told 200 very important people of his delight".*

## **Tea and Sympathy**

Suggested questions.....

1. Why do you think 'Nicky's Rules' help to make the Tea and Sympathy operation more efficient?
2. The restaurant's approach to quality of service seems very different to most restaurants. Why do you think it seems to work here?

### **Why do you think 'Nicky's Rules' help to make the Tea and Sympathy operation more efficient?**

In effect, Nicky's Rules are a way of managing customers and their expectations exclusively for the benefit of operational efficiency. Customers are warned that the waitresses are always right – in other words waitresses do not have to negotiate in order to get customers to do things, saving time and effort. Also, customers have to wait outside the restaurant until the entire party is present – customer groups must assemble themselves before entering the restaurant so the restaurant itself does not have to organise this. Customers are asked to change tables if necessary – this allows a closer match between demand and capacity. Customers are told to 'naff off' after they have finished the meal if the restaurant is busy – this helps to achieve higher utilisation in times of heavy demand. The rules are strictly enforced – very heavy management of customer expectations here!

### **The restaurant's approach to quality of service seems very different to most restaurants. Why do you think it seems to work here?**

Novelty of experience. Paradoxically, really bad service makes the character of the restaurant unique. The customers seem to appreciate being treated badly. This is a service philosophy also adopted by many universities!

## **Quality at Magic Moments**

Suggested questions.....

1. How has Magic Moments changed over time?
2. What do you think are the key challenges facing Magic Moments?
3. What do you think should be done to ensure the business is successful in the future?

### **How has Magic Moments changed over time?**

This short case box illustrates a number of key issues including, the role of product AND service in the value proposition, the way elements of product and service change over time, trade-offs between different aspects of the value proposition.

A good way to start the case debrief would be to get students to identify all the different product and service elements of the value proposition and show how these have changed over time. They could then explore the increasing level of customer interaction, the role of outsourcing in service delivery, the role of various stakeholders, and the tradeoffs between different aspects of the service.

The old photography business was simple, product-oriented, low variety (i.e. limited customisation), and relatively low interaction. The current business has many more service elements to the value proposition and the product almost acts as a hygiene factor (qualifier) for some clients. There is greater variety in both product and service elements of the business. This increased level of complexity may create challenges for consistent delivery. The high level of customer contact and interaction makes the whole value proposition more service-centric. Students should also discuss the issue of tradeoffs – how the photographer needs to find a good balance between getting the best photos (product elements) and keeping the guests happy on the day (service element).

#### **What do you think are the key challenges facing Magic Moments?**

The ideas for the future of the business focus on improving both product and service elements. As such, we start to see a shift towards a value proposition that is perhaps not dominated by either product or service, but is a true mix of both. Students can also explore the way outsourcing of non-core operations can help improve business delivery, which would lead nicely into the issue of core competence and the resource-based view of the firm. In this case, highly customised albums, and individual paintings are being considered, but the business does not have the competencies themselves to deliver these. Considering the idea of employing additional photographers in peak season, students can discuss the challenge of increasing scale in this kind of operation and issues around risk and reputation.

#### **What do you think should be done to ensure the business is successful in the future?**

The table below could be used / modified to illustrate the key issues in the case box.

#### **Magic Moments – past, present, and future**

	<b>Past</b>	<b>Present</b>	<b>Future</b>
<b>Product</b>	<b>Low variety</b> 30 photos in a standard album	<b>Medium variety</b> 500 photos on a CD 10 albums with 30-100 photos New wedding books	<b>High variety</b> Customised albums Wedding books Paintings
<b>Services</b>	<b>Low</b> Initial contact, dealing with bride and groom on the day	<b>High</b> Website viewing, initial contact, informal wedding planning, dealing with all guests on the day, some discussion after the wedding on album and photo options	<b>High</b> Website viewing, initial contact, formal wedding planning, dealing with all guests on the day, website for viewing and selling, discussion after the wedding to customise

			album, other photographer e.g. schools, studio etc.
<b>Interaction</b>	<b>Relatively low</b> 2 hours, focus on formal group shots	<b>High</b> Present for whole day, 'like another guest'	<b>Very high</b> Present all day and increased contact pre-wedding (planning) or post-wedding (customised products)
<b>Outsourcing</b>	<b>None</b> Photos, printing, and albums all done by the business	<b>Low</b> Printing outsourced	<b>Medium/High</b> Printing, albums, painting, website hosting, all to be outsourced. Possible extra photographers in peak season
<b>Stakeholders</b>	Focus on bride and groom	Bride and groom, but consider other guests	Bride and groom, but consider other guests and offer some services for them
<b>Trade-offs</b>	<b>Few</b> Simple business focused on photos	<b>Some</b> Between product and service	<b>Some</b> Between product and service; and between needs of different stakeholders

## Surgical statistics

Suggested questions.....

1. How does this new test change the likelihood of type I and type II errors?
2. Why is this important?

### How does this new test change the likelihood of type I and type II errors?

The four possible outcomes are shown in the table below:

<b>Decision</b>	<b>Patient's condition</b>	
	<b>Appendectomy not required</b>	<b>Appendectomy required</b>
Remove	Type I error	Correct decision
Don't remove	Correct decision	Type II error

Appendicitis is difficult to diagnose. Once appendicitis is suspected surgery is undertaken to remove the appendix yet many doctors are wary about suggesting surgery because of potential problems, and costs! Thus both type I and type II errors are likely. The new technique is said to be 100% effective in diagnosing appendicitis and so should significantly reduce both types of errors. It should eliminate type II provided doctors are willing to use the test to check their diagnosis. It should also reduce type I errors though doctors may be reluctant to pay for the test if they believe an appendectomy is not required.

#### **Why is this important?**

The cost of errors is significant. A type I error subjects the patient to unnecessary risks through invasive surgery, and the hospital to unnecessary costs, tying up theatre and staff time where it is not needed. A type II error puts the patient's life in jeopardy and the cost of surgery to clear a burst appendix coupled with an extended stay in hospital is significantly higher than the cost of the operation.

## **12.4 Further examples**

### **Quality at Torres Wine**

Back in 1870, Jaime Torres, having been forced to seek his fortune in Cuba when his elder brother inherited the family estates, returned to his native Catalonia. He founded the company which is now Spain's largest independently owned wine company with a turnover of around 17 million bottles of wine per year, together with around 6 million bottles of brandy. The (still family-owned) company's success is based firmly on the work it has put in to maintain the quality and consistency of its products. This starts with the vineyards themselves. Since the 1960s they have been experimenting with matching grape varieties to the individual microclimates in their estates, planting patterns which preserve water levels in the soil, and using environmentally friendly cultivation techniques such as the laser-guided plough, which eliminates the need for artificial chemical weed killers. Although much of the harvesting is still done by hand, mechanical harvesting (see picture) not only saves time and money, but also allows the fruit to be collected cool during the night and early morning, which further enhances quality. The trailers and tractors which transport the harvested grapes are unloaded into reception hoppers where precision controlled systems, coordinated by computer electronics, enable immediate assessment of the quality and ripeness of grapes. The wines ferment in visually striking stainless steel towers (see picture). All these vats are equipped with cooling systems to ferment the grape juice at a controlled temperature, thus preserving its natural aromas. Torres' cellars, where the red wines are aged, extend through two kilometres of cool, dark, underground galleries that house more than 11 000 oak barrels. The use of new oak barrels for ageing the finest wines requires substantial investment, but it is an essential factor in obtaining the highest quality. The wine is then bottled in the company's on-site modern bottling plant, after which it is bottle-aged in the company's headquarters at nearby Vilafranca.

Suggested questions....

- 1 What constitutes quality for Torres' products?
- 2 Chart the various stages in wine-making and identify what influences quality at each stage.
- 3 What do you think Torres does, or can do, to pursue environmentally friendly production?

**What constitutes 'quality' for Torres' products?**

Quality is consistent conformance to customers' expectations. For Torres this means producing a range of products with consistent characteristics which meet the needs of their customers.

The quality characteristics will include:

Quality characteristics	
Functionality	Tasty, alcoholic drinks
Appearance	Appropriate colour, texture and smell to the wines and shape, colour and labelling of the bottles
Reliability	Every bottle of the same type tastes (given year variations) the same
Durability	The wine will keep for an appropriate length of time
Recovery	Problems of consistency of wine quality, availability of supply and invoicing etc are rapidly dealt with
Contact	The staff who deal with the suppliers and the wholesalers who buy their products are treated fairly and courteously

**Chart the various stages in winemaking and identify what influences quality at each stage.**

Stages in wine making	Key influences on quality
Grape growing	Correct grape for soil and climate Planting patterns Cultivation techniques Weather Diseases
Harvesting	Timing Temperature
Grape delivery	Speed from vineyard to wine maker Foreign bodies Cleanliness of grapes
Reception hoppers	Cleanliness Temperature
Quality assessment	Reliability of instruments Precision of tests
Mashing	Temperature Time Skin removal, where appropriate



<b>Fermentation</b>	Temperature Time Yeast content
<b>Barreling</b>	Cleanliness Contamination
<b>Aging</b>	Light Temperature Time
<b>Bottling</b>	Cleanliness Contamination
<b>Bottle aging</b>	Light Temperature Time
<b>Distribution</b>	Handling

With so many factors influencing the quality of the wines, many of which are outside of the control of the growers and the wine makers, it requires a significant amount of work to ensure the quality of the final products. Checks along the way, at every stage, are built in to ensure appropriate conditions. The cost of a failure at almost any stage could in some cases jeopardise an entire year's production. A failure in the aging process could jeopardise several years' worth of wine.

#### **What do you think Torres does, or can do, to pursue environmentally friendly production?**

Torres is already concerned about environmental growing and production methods. The company works closely with its suppliers, providing them with advice and guidance that not only helps them grow the best grape for the microclimate but use environmentally friendly cultivation techniques. Other questions which can be raised, but not answered in the illustration, include does the company use oak from sustainable forests, and recycled glass for example?

### **Security scanning**

Humans are not good at inspection, especially over extended periods. When inspection can be a matter of life and death, as in airport security, they need all the help from technology they can get. Although scanners and metal detectors are used at all the worlds' major airports, the technology on which they are based is getting much more sophisticated. For example, the technology company QinetiQ (pronounced kinetic) has developed an advanced imaging system that can detect weapons and explosives concealed under a person's clothing or in their baggage. Their 'multi-threat' airport security portal provides moving image scanning and could revolutionise transport and border security. What's more, because it operates in real time it could reduce queues at security scanners in airports and other public places.

The portal uses 'Millimetre Wave' technology that has its origins in a QinetiQ research programme that helps pilots to see through fog and cloud. "We've actually come up with dozens of potential applications, from guiding airliners to their boarding gate in zero visibility to spotting people carrying concealed weapons going into football grounds or trying to conceal themselves

in vehicles,” says Jeremy Attree, Director of Sales for QinetiQ’s Sensors and Electronics Division. “The device works by detecting naturally occurring radiation as it reflects off different objects. Metal objects completely reflect naturally occurring radiation. Other plastic and ceramic weapons as well as explosives hidden under clothing or in baggage also appear on the scanner’s display as distinct illuminated shapes. The human body reflects 30% of the naturally occurring radiation around it, and this enables the scanner to detect a person’s actual body shape beneath their clothes. So, attempts to conceal items under clothing can be foiled by the device”.

The system has a number of practical benefits. In contrast to active detection systems incorporating low-level radiation emissions (e.g. x-ray scanners), QinetiQ’s airport security camera is a passive detection system, and therefore does not expose individuals to harmful radiation. Also, because the system works in real-time and provides an accurate moving image, vehicles or persons can be scanned without being stopped, thus greatly reducing transit time through security checkpoints. At one trial of the new technology, passengers were asked to be screened and then underwent a conventional ‘pat-down’ search, so that normal security procedures were also observed. Almost all participants preferred the far less invasive Millimetre Wave option. “In the aftermath of September 11th airline passengers need additional reassurances that every effort is being made to ensure their safety. Because the system provides an accurate moving image, without compromising effective screening, transit time through security checkpoints can be significantly improved, without impacting on performance,” explained Kevin Murphy, Product Manager for the Millimetre-Wave Imager. Suggested question....

1 What do you think are the advantages and disadvantages of both human inspection and technology-assisted inspection in assisting airport security processes?

### **What do you think are the advantages and disadvantages of both human inspection and technology-assisted inspection in assisting airport security processes?**

Human inspection is unmatched for being able to detect seemingly insignificant clues. Behaviour of passengers, for example, would be difficult to gauge using technology but human beings, used to normal patterns of appearance and behaviour, can identify unusual or potentially dangerous behaviour in individuals. However, humans are bad at consistently inspecting to a set pattern for long periods of time. Technology-assisted inspection, such as the one described in the box, has the very opposite characteristics. It cannot detect unusual patterns of behaviour but it can detect offensive weapons no matter how well concealed they are. Furthermore, it can be (again, as in the case of the technology described in the box) be fast and unobtrusive in inspecting individuals as they move through the system. Remember though that technology-assisted inspection often also relies on human judgement. A knife or gun may show up on the technology-assisted inspection but humans still have to maintain their vigilance of the results that the technology gives them.

### **Process control at Walkers**

Walkers Snack Foods Limited, part of the worldwide Pepsico Company, operates in a highly competitive sector of the fast-moving consumer goods (FMCG) market. With increasingly discriminating customers, they need the competitive edge of high-quality manufacturing to help them retain customer satisfaction. This means that they must keep close control of all their manufacturing processes, a task which is especially difficult when success of your products means booming sales and therefore continually increasing production volumes. Walkers uses a

version of statistical process control, which they call 'control point management' (CPM), to maintain and improve their quality levels. The picture shows a team leader in the company's Doritos plant completing control chart sheets. The control points in the manufacturing process where process variables are measured are all specified for each production line. If any measurements fall outside the control limits, procedures in the form of decision trees help to guide the production technicians in bringing the process back within standard.

Suggested questions....

- 1 What do you think are the characteristics of product quality for Walkers products which influence overall customer satisfaction? (Sample a packet and discuss this with friends!)
- 2 Why is it important that direct production staff, as opposed to managers or engineers, collect and analyze process data?
- 3 What purpose do the 'corrective' decision trees serve in controlling the process?

**What do you think are the characteristics of product quality for Walkers products which influence overall customer satisfaction? (Sample a packet and discuss this with friends!)**

<b>Quality characteristics</b>	
<b>Functionality</b>	Snack – quick and tasty treat, not too few and not too many items per packet.
<b>Appearance</b>	Crispness, colour, taste of the product plus the appearance of the packaging
<b>Reliability</b>	Every packet is as good as the last packet
<b>Durability</b>	The packets will keep for a reasonable length of time at the retailer and in the home
<b>Recovery</b>	The company is willing to re-imburse consumers for poor products using the information provided to deal with production or storage problems

**Why is it important that direct production staff, as opposed to managers or engineers, collect and analyse process data?**

It is now commonplace to find direct production workers collecting and analysing process data and making changes to the process if necessary. Although engineers may set the control limits and sampling plan, using staff in this way provides them with responsibility and control over their own process (see chapter 9) and also allows swift action without the need to consult engineers or managers.

**What purpose do the 'corrective' decision trees serve in controlling the process?**

The 'corrective' decision trees provide a means of identifying root causes of a problem and through this simple algorithm and the provision of the necessary changes for each cause prevents 'trial and error' decisions by operators. By analysing all the possible types of problems that the

process might incur and the solutions for each one engineers can allow production workers to control the process knowing that, in the main, the right decisions will be made.

## **SPC case - AEB Mortgage Services**

*"It is quite difficult to know exactly how long operators should be spending on each call. Sometimes a client really does need detailed advice or reassurance, at other times the call could be dealt with very quickly indeed. There's a minimum amount of time just to go through the courtesies. But there's also an upper limit. No matter how complex the call, our systems should be able to cope with it within a set time limit. My main concern is that we really do not know how much we should expect calls to vary."* (Duncan Hindes, Mortgage Services Manager, AIB)

Duncan was speaking in early 1997 just after AIB had made a considerable investment in its new call centre information technology project. The new system had been 'up and running' for several weeks now and was generating considerable amounts of data. All of this data was monitored and stored, but Duncan felt that he should be making more use of the information. The average length of phone calls was a particular concern to him. He had a suspicion that the calls were varying too much and that operators should be able to control even the longer calls. He also felt that it should be possible, at the same level of service quality, to get the average call time down under two and half minutes (it was a little above this at the moment).

*"If operators spend too little time with clients we can lose both valuable opportunities to collect important information from them, make them feel 'dismissed', and sometimes waste an opportunity to sell them further services. On the other hand if operators spend too much time we are obviously reducing the effective capacity of our unit and wasting valuable operator time."* (Duncan Hindes)

Duncan decided that he could exploit the data monitoring system in the call centre in order to chart the average call length, and its variability, over time. As a first attempt to do this, he used the system to sample six conversations at random every hour. He then requested the system to calculate the average length of call for the sample and the range of call lengths (the difference between the longest and the shortest call in the sample) for each sample. This data is shown in Exhibit 1.

*"I'm not sure what this tells us. Certainly there is more variation in the length of call than I would have expected, but I am not sure what we can do to reduce this."* (Duncan Hindes)

Duncan was convinced that he could take actions which would both speed up the process and reduce the variability of the length of calls. Several options were open to him. He could easily get the new IT system to reinforce the idea of the 'target call length' in the operators minds by putting reminders on screen when the calls exceeded a certain length of time. He could even reinforce the bonus system to put greater emphasis on the number of calls handled by each cell per week (currently the payment system gave a small bonus related to both productivity and quality). More controversially he could put pressure on the operators to make better use of the new IT system. Although the new system was much more sophisticated than the old, operators often reverted to using the old system (which was still on-line) because they were familiar with it and made fewer mistakes. Finally, he could increase the emphasis on the degree of monitoring

carried out by the supervisors. The new system could allow supervisors to sample average call lengths for each operator and flash up warning messages when average call times got above a certain level.

*"I guess what we should do now is change some of these parameters to try and reduce the variability of calls. Personally, I am in favour of using all four options. In particular we could easily get the system to flash up messages to the operators if their calls exceed a certain time. At the same time, it is important that we move them quickly on to the new IT system. We can do this easily simply by accelerating our existing programme of decommissioning the old system. As it is gradually taken off line, the operators will be obliged to move on to the new system."*  
(Duncan Hinds)

## EXHIBIT 1

Call length sampling results – 6 calls per sample

Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Average call length	2.5 5	1.4 7	2.4 9	3.1 5	2.5 7	2.5 8	2.1 8	2.1	2.3 4	2.3 6	2.4 1	2.1 6	3.2 4	2.3 9	2.0 6
Range of call lengths*	3.4 9	3.1 3	5.3 3	5.4 7	5.3 7	6.1 8	3.3 7	5.2 3	3.2 1	3.1 4	3.1 9	5.1 7	5.4 8	5.2 1	2.5 2

\*Range = longest call time in sample – shortest call time in sample.

## Calling Sue

The idea of having a Personal Banking Consultant (PBC) seemed a great one at the time it was suggested. For a modest annual fee we would get a differentiated range of 'relationship' financial services designed for busy business people like us. These were listed in an attractive glossy 'membership' brochure and included: a larger overdraft facility with preferential interest rates, free annual travel insurance, a rewards point scheme, a 'gold' credit card with no credit limit, and our own PBC (Sue) and her personal assistant (Richard), who would be there to help whenever we needed them. Every other aspect would be as before, but our accounts would have to be transferred from our old branch in the south (where we lived until six years ago, but never bothered to move our accounts) to the north, where we now work. Having a remote bank branch had not been a problem until recently. If we needed anything done with any account, we simply had to ring the Assistant Manager in the south and he arranged it. But recently, a Southern West Region Office was established, and all phone calls were handled remotely, so it had become more difficult to maintain this personal relationship. Moreover, our business and private accounts were handled by separate people at different offices, using different telephone numbers. We were ready for a change!

Despite the attractions of the package described, we were hesitant to accept this generous offer. Changing all the cheque books, credit cards, standing orders, direct debit instructions, and anything else we had forgotten, including our personal and business accounts, seemed rather

complex and time-consuming. We raised these concerns with the advisor who had been sent to sell us the idea, one dark December Monday.

*'Oh, there will be absolutely no problem ... we can deal with all that. All you and your wife will have to do today is to sign a few forms authorizing us to transfer the accounts, and one to agree to the new arrangements. Then leave the rest to us. There will be no problems, it's easy with all the technology we have today. You should get the new cheque books within seven days, and all balances will be transferred automatically by the computer'.*

We signed up immediately – it looked a good scheme, and even the value of the free insurance alone would more than compensate for the annual membership fee.

The four cheque books for the two accounts arrived separately, over a three-day period, the last arriving on the Tuesday, nine days after the agreement. The business account cheques had an incorrectly spelt business name, and the current account cheques had my wife's initials reversed. At the same time we received (from Sue) a personalized welcoming pack and a professionally presented loose-leaf folder of information concerning the account and PBC services, which confirmed that the accounts were in operation. All this correspondence was correctly addressed and written in a friendly style, using our first names. I decided to call Sue about the spelling.

*'I'm awfully sorry, sir, I'll order some new ones, and I will ask them to send them to you quickly. I know they've had a backlog due to computer problems at the card centre, but they can prioritize any PBC's cards. In the meantime, you can use your existing accounts, since they are linked to your new ones. I'll call you to confirm when this has been done. Again, may I apologize for any inconvenience you have experienced.'*

One hour later she rang as promised, confirming her actions.

On the tenth day our credit cards arrived, correctly embossed with our names. However, these could not be used for cash withdrawals without personal identification numbers (PINs) and the cheques could not be used in UK retail outlets without cheque guarantee cards. The cheque guarantee card doubled as a cash card, for use at ATMs with another PIN number. Neither PIN number had arrived by the second Friday after our signing-up (11 days). I decided to call Sue, to see what was happening.

*'Don't worry,' she said, confidently, 'The PINs always come a day or two after the cards, for security reasons, and you should get the guarantee cards about the same time.'*

By the following Friday lunchtime, returning from a week's business trip, we were getting concerned. Although our new cheque guarantee cards had arrived and were correct, our names on the envelope were again incorrect, which seemed odd and slightly disconcerting. We still had not received the new PIN numbers. I decided to call Sue, who apologized again, politely expressing her amazement at our dilemma, and asked me to hold while she checked the system. *'They have certainly been correctly issued on Monday'*, she said confidently, *'and have been sent ... perhaps they have been lost in the post. I'll check with the card centre what we should do, and I'll call you back.'*

*'You will have to be quick,' I retorted, 'We're just about to leave for a long weekend vacation, but you could call me on the mobile ...'.*

Sue phoned two hours later and confirmed that because the PIN numbers had been mislaid, it would be necessary to re-issue the cards for security reasons. *'You should receive the replacement cards and PIN numbers within three days,'* she stated confidently. *'You should carry on using your original account's cards until then.'*

Her suggestion seemed okay at the time, but proved to be rather more of a problem than we had anticipated. On checking out of the hotel on Monday evening, we discovered that the existing credit card had expired, and the bill came to more than our existing cheque guarantee

card limit. We settled the account with a combination of cheques and most of our remaining cash – an embarrassing end to a pleasant weekend.

In the post on Tuesday morning, we were surprised to receive two sets of PIN numbers, along with further cheque guarantee cards *and* credit cards. We went to the ATM with our new cards to draw out much needed cash, but the PINs weren't accepted. Careful examination of the packaging revealed that the PINs related to the original cards, not the replacements! We borrowed cash from a friend and called Sue!

By Friday, everything was working and we had received a correctly addressed letter of apology from the card issuing centre in Glasgow. An excellent bouquet of flowers was delivered that afternoon and Sue phoned to check we were now happy. She even called in to see us a week later, bringing some leather holders for cards and cheque books. We have had no more problems and generally the service is excellent. Sue has, however, confided that such problems are quite common (they apparently use a lot of agency staff in the processing centres, and mistakes are common).

But we can always call Sue.

## **Calling Sue – Teaching note**

### **Questions**

- 1 What were the gaps between the customers' expectations and perceptions in the process described?
- 2 How were the customers' expectations influenced from the outset?
- 3 What aspects of the bank's service quality specification have been revealed to the customer? Are these reasonable for such an account?
- 4 Evaluate Sue's reaction to the problems at every stage. Was the bank's service recovery successful?
- 5 What costs have been created by these problems, and how do they compare with the underlying costs at the root cause of the problem?

### **What were the gaps between the customers' expectations and perceptions in the process described?**

There was a significant mismatch between customers' expectations and perceptions, i.e. poor perceived quality. Although the problems were eventually sorted out the events may have left a sour taste in the mouth of the customer making them even more wary of the bank and any future offers.

Looking at each of the gaps in turn:

Gap 1: The customer's specification-operation's specification gap

There does not appear to have been a mismatch between what we can assume to be the operational specification (new cheque books within seven days, automatic transfer of balances,

overdraft facility, annual travel insurance, gold card and the use of a PBC), as promised by Sue, and the customers' requirements. We do not however know what the internal specification was for these activities. It is possible that the standards were not as needed which would lead to such a gap.

#### Gap 2: The concept-specification gap

It is difficult to know if there was a mismatch between the service concepts developed by the bank and the detailed specification of the products and services. One assumes not. The problem of which we are acutely aware pertains to gap three.

#### Gap 3: The quality specification-actual quality gap

This is an important gap in this case. It appears that Sue was well aware of the problems that were often incurred in these transfers, she referred to these 'computer problems' but later admitted to problems with agency staff. Rather than warn the customers of the problems and setting appropriate expectations, she had promised something that she knew would be difficult to deliver. Was this a good idea? Yes, in so far as the transfer was undertaken and she kept the business, but no in that she has created somewhat dissatisfied customers who are now even more wary of their relationship with the bank and who may, if they should experience another problem, terminate their valuable accounts.

It is important to remember that all the other parts of the promise (we assume) were kept – annual travel insurance, gold card etc. The problems that were experienced were only in the transfer process. However particular promises had been made about this which were not delivered.

#### Gap 4: The actual quality-communicated image gap

One might argue that there was no mismatch here. The customers were extremely wary about transferring their account because they had experienced problems with the bank in the recent past. However the communication they received from Sue provided them with the reassurance they needed to make the decision, which as we know were rather hollow promises.

#### **How were the customers' expectations influenced from the outset?**

The customers were wary of making the changes to their accounts. They had experienced several other problems with the bank – remote and impersonal handling of their calls at a regional call centre, lack of access to their 'trusted' assistant bank manager, and different telephone numbers for the two types of accounts. Their expectations were not high though they needed a solution to the problem that the bank had created for them. Sue, however, had had a significant influence on their expectations by explaining that 'there will be absolutely no problem' and that they 'should get the new cheque books within seven days'. They went ahead on the basis of trust.

#### **What aspects of the bank's service quality specification have been revealed to the customer? Are these reasonable for such an account?**

We can assume that the bank delivered on its promises to provide annual travel insurance, gold credit card and a larger overdraft facility, and such specifications should appear to be quite reasonable for such an account. The fact that errors are common at the processing centres due to the use of agency staff is not appropriate for **any** type of account. The prime concern of bank



customers is an error free service and this underpins customers' relationship with the bank. The use of agency staff implies that the bank is having problems dealing with demand yet consultants such as Sue are pressing clients to make the changes presumably trying to meet their own targets. This would suggest serious managerial problems in terms of coordination, target setting and capacity management.

**Evaluate Sue's reaction to the problems at every stage. Was the bank's service recovery successful?**

<b>Problem</b>	<b>Sue's response</b>
One cheque book arrived after 9 days	Sue was not told of this problem.
Business accounts had incorrect spellings and current account had wife's initials reversed	Sue apologised and ordered speedy dispatch of new ones assuring customers that they could use the old ones in the interim. She promised to confirm her actions which she did.
The credit/cash cards arrived without the PINs	Sue explained they would take a day or two.
One week later they still had not arrived.	Sue apologised, checked her records and suggested they had been lost in the post. Agreed to re-issue the cards.
Names on envelope still incorrect, but correct names on cheque guarantee cards.	Next letter was correctly addressed.
Credit cards had expired and ATM would not accept PINs for the original cards	Sue apologised and sent a bouquet of flowers. She also personally provided leather holders and cards and chequebooks.

Sue reacted as well as she could to each stage. The problems were systemic rather than personal, which these customers seem to have accepted. Although they were dissatisfied during the process Sue appears to have done enough to appease them. Given they have had no problems since, customer satisfaction appears to have been restored, however any further problems, small or large, might well have led to a less measured response from the customers.

**What costs have been created by these problems, and how do they compare with the underlying costs and root cause of the problem?**

The costs created by these problems include Sue's time, though this is what she is paid for, the costs of rework (reproducing and reissuing the cards and cheque books), the costs of compensation (flowers, leather holders and delivery) and the costs to the customers (goodwill, inconvenience and embarrassment). The root causes of the problems are poor capacity management, lack of communication between departments and inappropriate target setting. Some of these, in particular capacity changes, could be expensive to deal with and the recovery procedures seemed to be being used to alleviate the problems in the short term. The critical issue is whether the bank dealt with these problems in the long term.

## Turnround at the Preston plant

*"Before the crisis the quality department was just for looks, we certainly weren't used much for problem solving, the most we did was inspection. Data from the quality department was brought to the production meeting and they would all look at it, but no one was looking **behind** it."*  
(Quality Manager, Preston Plant)

The Preston plant of Rendall Graphics was located in Preston, Vancouver, across the continent from their headquarters in Massachusetts. The plant had been bought from the Georgetown Corporation by Rendall in March 2000. Precision coated papers for ink-jet printers accounted for the majority of the plant's output, especially paper for specialist uses. The plant used coating machines that allowed precise coatings to be applied. After coating, the conversion department cut the coated rolls to the final size and packed the sheets in small cartons.

### The curl problem

In late 1998 Hewlett Packard (HP), the plant's main customer for ink-jet paper, informed the plant of some problems it had encountered with paper curling under conditions of low humidity. There had been no customer complaints to HP, but their own personnel had noticed the problem, and they wanted it fixed. Over the next seven or eight months a team at the plant tried to solve the problem. Finally, in October of 1999 the team made recommendations for a revised and considerably improved coating formulation. By January 2000 the process was producing acceptably. However, 1999 had not been a good year for the plant. Although sales were reasonably buoyant the plant was making a loss of around \$2 million for the year. In October 99, Tom Branton, previously accountant for the business, was appointed as Managing Director.

### Slipping out of control

In the spring of 2000, productivity, scrap and re-work levels continued to be poor. In response to this the operations management team increased the speed of the line and made a number of changes to operating practice in order to raise productivity.

*"Looking back, changes were made without any proper discipline, and there was no real concept of control. We were always meeting specification, yet we didn't fully understand how close we really were to not being able to make it. The culture here said, 'If it's within specification then it's OK' and we were very diligent in making sure that the product which was shipped **was** in specification. However, Hewlett Packard gets 'process charts' that enables them to see more or less exactly what is happening right inside your operation. We were also getting all the reports but none of them were being internalized, we were using them just to satisfy the customer. By contrast, HP have a statistically-based analytical mentality that says to itself, 'You might be capable of making this product but we are thinking two or three product generations forward and asking ourselves, will you have the capability then, and do we want to invest in this relationship for the future?'"* (Tom Branton)

The spring of 2000 also saw two significant events. First, Hewlett Packard asked the plant to bid for the contract to supply a new ink-jet platform, known as the Vector project, a contract that would secure healthy orders for several years. The second event was that the plant was acquired by Rendall.

*"What did Rendall see when they bought us? They saw a small plant on the Pacific coast losing lots of money."* (Finance Manager, Preston Plant)

Rendall were not impressed by what they found at the Preston plant. It was making a loss and had only just escaped from incurring a major customer's disapproval over the curl issue. If the plant did not get the Vector contract, its future looked bleak. Meanwhile the chief concern

continued to be productivity. But also, once again, there were occasional complaints about quality levels. However HP's attitude caused some bewilderment to the operations management team.

*"When HP asked questions about our process the operations guys would say, 'Look we're making roll after roll of paper, it's within specification. What's the problem?'" (Quality Manager, Preston Plant)*

But it was not until summer that the full extent of HP's disquiet was made. *"I will never forget June of 2000. I was at a meeting with HP in Chicago. It was not even about quality. But during the meeting one of their engineers handed me a control chart, one that we supplied with every batch of product. He said 'Here's your latest control chart. We think you're out of control and you don't know that you're out of control and we think that we are looking at this data more than you are.'" He was absolutely right, and I fully understood how serious the position was. We had our most important customer telling us we couldn't run our processes just at the time we were trying to persuade them to give us the Vector contract."* (Tom Branton)

### **The crisis**

Tom immediately set about the task of bringing the plant back under control. They first of all decided to go back to the conditions which prevailed in the January, when the curl team's recommendations had been implemented. This was the state before productivity pressures had caused the process to be adjusted. At the same time the team worked on ways of implementing unambiguous 'shut-down rules' that would allow operators to decide under what conditions a line should be halted if they were in doubt about the quality of the product they were making.

*"At one point in May of 2000 we had to throw away 64 jumbo rolls of out-of-specification product. That's over \$100,000 of product scrapped in one run. Basically that was because they had been afraid to shut the line down. Either that or they had tried to tweak the line while it was running to get rid of the defect. The shut-down guidelines in effect say, 'We are not going to operate when we are not in a state of control'. Until then our operators just couldn't win. If they failed to keep the machines running we would say, 'You've got to keep productivity up'. If they kept the machines running but had quality problems as a result, we criticized them for making garbage. Now you get into far more trouble for violating process procedures than you do for not meeting productivity targets."* (Engineer, Preston Plant)

This new approach needed to be matched by changes in the way the communications were managed in the plant.

*"We did two things that we had never done before. First each production team started holding daily reviews of control chart data. Second, one day a month we took people away from production and debated the control chart data. Several people got nervous because we were not producing anything. But it was necessary. For the first time you got operators from the three shifts meeting together and talking about the control chart data and other quality issues. Just as significantly we invited HP up to attend these meetings. Remember these weren't staged meetings, it was the first time these guys had met together and there was plenty of heated discussion, all of which the Hewlett Packard representatives witnessed."* (Engineer, Preston Plant)

At last something positive was happening in the plant and morale on the shop floor was buoyant. By September 2000 the results of the plant's teams efforts were starting to show results. Process were coming under control, quality levels were improving and, most importantly, personnel both on the shop floor and in the management team were beginning to get into the 'quality mode' of thinking. Paradoxically, in spite of stopping the line periodically, the efficiency of the plant was also improving.

Yet the Preston team did not have time to enjoy their emerging success. In September of 2000 the plant learned that it would not get the Vector project because of their recent quality problems. Then Rendall decided to close the plant. *"We were losing millions, we had lost the Vector project, and it was really no surprise. I told the senior management team and said that we would announce it probably in April of 2001. The real irony was that we knew that we had actually already turned the corner."* (Tom Branton)

Notwithstanding the closure decision, the management team in Preston set about the task of convincing Rendall, that the plant could be viable. They figured it would take three things. First, it was vital that they continue to improve quality. Progressing with their quality initiative involved establishing full statistical process control (SPC).

Second, costs had to be brought down. Working on cost reduction was inevitably going to be painful. The first task was to get an understanding of what should be an appropriate level of operating costs. *"We went through a zero-based assessment to decide what an ideal plant would look like, and the minimum number of people needed to run it."* (Tom Branton)

By December of 2000 there were 40 per cent fewer people in the plant than two months earlier. All departments were affected. The quality department shrank more than most, moving from 22 people down to 6. *"When the plant was considering down-sizing they asked me, 'How can we run a lab with six technicians?' I said, 'Easy. We just make good paper in the first place, and then we don't have to inspect all the garbage. That alone would save an immense amount of time.'"* (Quality Manager, Preston Plant)

Third, the plant had to create a portfolio of new product ideas which could establish a greater confidence in future sales. Several new ideas were under active investigation. The most important of which was 'Protowrap', a wrap for newsprint that could be repulped. It was a product that was technically difficult. However the plant's newly acquired capabilities allowed the product to be made economically.

### **Out of the crisis**

In spite of their trauma, the plant's management team faced Christmas of 2000 with increasing optimism. They had just made a profit for the first time for over two years. By spring of 2001 even HP, at a corporate level, were starting to take notice. It was becoming obvious that the Preston plant really had made a major change. More significantly, HP had asked the plant to bid for a new product. April 2001 was a good month for the plant. It had chalked up three months of profitability and HP formally gave the new contract to Preston. Also in April, Rendall reversed their decision to close the plant.

### **Questions**

1. What are the most significant events in the story of how the plant survived because of its adoption of quality-based principles?
2. The plant's processes eventually were brought under control. What were the main benefits of this?
3. SPC is an operational level technique of ensuring quality conformance. How many of the benefits of bringing the plant under control would you class as strategic?

### **Turnround at the Preston plant – Teaching note**

This case is essentially a story of how a relatively small factory, supplying ink jet paper to Hewlett Packard and other customers moved itself from being a loss-making operation into a profitable position by gaining control of its processes. The case covers a period from late 1998 through until April 2001 with the case relating events in chronological order. The company buys in large rolls of paper from paper manufacturers, applies very precise coatings of chemicals to the paper that enable it to take ink jet printing at high quality levels, and then slits and shears the paper into standard sizes. This paper is then packed, with the packaging dependent on the customer for who the paper is being produced. The most difficult operation is the coating process and it is this process that is out of control (in the statistical process control sense). During the case the plant is sold by one group and bought by another. Its new owners, the Rendall Graphics Company, takes the decision to close the plant. However, over a period of time, Tom Branton, the Managing Director of the plant, takes a series of action that improve quality and reduce cost in the plant. Eventually, the closure decision is reversed.

This case can be used as a general introduction to the importance of process control. It is useful if students have at least a broad understanding of process control before tackling the case. They do not need to have an in-depth familiarity with the statistics involved (although this is useful), but they should understand the nature of how process control tackles variation in process performance. The case can then be used to demonstrate how the idea of variation reduction is fundamental to improving the performance of processes. An important issue that can be drawn out of the case is that the distinction between detailed process management on one hand and strategic impact on the other hand, is not that great. In other words, although some of the details of process control may seem to be detailed and 'technical', its impact can be very strategic indeed.

### **Note on questions**

#### **Question 1 – What are the most significant events in the story of how the plant survived because of its adoption of quality-based principles?**

The best way to debrief this question is simply to ask the class to call out the most significant events in the order that they occur in the story. As each point is written down on the board, one can make comments appropriate to the point but also to what ever else is being covered in the class. Some of the main points are discussed below.

**The curl problem** (late 1998) – Hewlett Packard (HP) the plant's main customer, said that they had encountered a problem with paper curling under conditions of low humidity. Ask the class, "*had HP received any complaints?*" No. Then, "*What does that tell you about the nature of HP as a customer?*" Most students will say that HP is a 'difficult or demanding' customer. Ask them, "*Is it good to have demanding customers?*" Many experienced students will say, yes, to this question. It may be useful to remind them that, of course it is good to have demanding customers because you can learn from them. However, it does not always feel like that when you are actually dealing with demanding customers. The important issue is to make sure that their complaints really are treated as a learning opportunity.

**The curl problem solved** (January 2000) – The curl problem obviously took a long time to solve. Why was this? Either it was a particularly difficult problem (unlikely) or the Preston plant does not seem to be fast on its feet in responding to customer requests (more likely). Also

during this period (1999) the plant had been making a loss and scrap and rework levels were continuing at unacceptable levels. Ask the class, *"What was the response of the company to this?"* The plant's operations management team increased the speed of the line and made a number of changes to operating practice in order to raise productivity. Ask the class, *"Was this a good or bad thing to do?"* A bad thing because it did not tackle the underlying causes of the problems. In fact, it made them worse. Speeding up a process that is already out of control and making unrecorded changes to the process while it is operating will only make things worse. Also, there was clearly no understanding of the nature of process variation. (If it's within specification then it's OK). In fact, the plant was only shipping product that was within specification to Hewlett Packard, and throwing the rest away. They seemed surprised that HP (because of their understanding of process variation) could see that this was happening.

**The plant asked to bid for the Vector project** (Spring 2000) – This was an important new contract that would have secured work for several years.

**The plant is bought by Rendall** (Spring 2000) – However, the acquisition was part of a larger acquisition and Rendall were not impressed with either the strategic importance or the performance of the Preston plant. Productivity and quality issues were still very problematic. Ask the class, *"How did people in the plant view HP's concerns?"* They could not really understand them ("Look, we are making roll after roll of paper, it's within specification. What's the problem?")

**The crisis becomes evident** (June 2000) – Tom Branton is told by an HP engineer that their processes are not in control. Ask the class, *"Why do you think this had such an impact on Tom Brandon?"* Possibly because this engineer at HP, probably sitting hundreds of miles away from the Preston plant, could tell Tom more about his processes than Tom understood, and he was working right next to them. This is the real power of process control charts. By looking at variation in performance one can understand the nature of the processes even if you haven't seen them. Ask the class, *"What did Tom do then?"* He went back and did three things.

- He developed 'shut-down rules' with the operators. These unambiguously stated when a process must be shut down because there were doubts about the quality levels of the process. How did the operators feel about this? It removed the ambiguity from their job. No one could criticize them if they shut the line down provided that they had obeyed the shut-down rules.
- Each production team started holding daily reviews of control chart data. Why do you think this was a good thing? Because it meant that each team had a chance to reflect on what had happened that day and how it could be improved. Furthermore, the control charts became the centre of discussion. This would mean that significant training in statistical process control would be necessary, but this would add to the skills of the operators.
- One day a month all three shifts got together to discuss progress. Why was this a good thing? All three shifts could get together and learn from each other. It also showed how committed the plant was to putting things right. Ask the class, *"As well as the three shifts, who else was at these meetings?"* Personnel from HP. Ask the class, *"What are your reactions to that?"* Many of the class will remark that it is a very brave thing for the Preston plant to do. Ask them why they think Tom Brandon did this. Probably desperation. He had already realized that HP fully understood how bad they were, so what was there to lose?

**Starting to show results** (September 2000) – A real sense that things were changing and people were starting to think in the ‘quality mould’. In spite of stopping the line periodically, the efficiency of the plant was also improving. Ask the class, *“Why do you think this was so?”* Because stopping the plant meant that the operators and the management had to tackle the problems, which in turn prevented them happening again, and so quality and productivity would improve.

**Failure to get the Vector project** (September 2000) – The recent quality problems had undermined HP’s faith in the company.

**Rendell decide to close the plant** (September 2000) – Ask the class, *“Do you think this was a reasonable decision?”* There may be some debate about this. But, bring out the point that Rendall’s head office would judge the plant primarily in financial terms and these had not improved. At an operational level it was clearer that something was happening but it takes time for these to work through to the financial measures. Ask the class, *“What did Tom decided to do?”* He did not despair! In fact, he carried on trying to improve the plant. Ask the class, *“Why do you think he did this?”* Perhaps he figured that he could get Rendall to reverse their decision. Also, it was probably a matter of ‘professional pride’. The management team had already started to turn the plant round so, what else were they going to do? Just let all their hard work fade away? Ask the class, *“What did he do to continue the improvement?”* He did three things.

- He continued the quality initiative making even more use of SPC.
- He reduced operating costs by taking people out of the plant (ceasing to employ them). He used a zero-based approach to this. It might be useful to discuss the nature of zero-basing as an approach to making staffing decisions. It is a radical but effect method of determining exactly how many people are needed from first principles rather than from historical precedent. Ask the class, *“Which department downsized the most?”* It was the quality department (ironically). Ask the class, *“Why was that so?”* Because if you are not making garbage you don’t need to check it all the time.
- The plant developed new products. Ask the class, *“Did the improvement in their process performance help them develop these new products?”* Yes it did. The Protowrap product could not have been made without the improvement in technical capability that came from the SPC initiative.

**The plant makes a profit** (Christmas 2000) – This means increasing optimism within the plant.

**HP asks the plant to bid for a further new product** (Spring 2001) – Because HP had recognized the changes that had taken place in the plant.

**HP give the new contract to the Preston plant** (April 2001) – More good news.

**Rendall reverse the closure decision** (April 2001) – and everybody lived happily ever after.

**Question 2 – The plant’s processes eventually were brought under control. What were the main benefits of this?**

Ask the class a series of questions and encourage them to identify the various benefits. For example,

- How did gaining control of the process help to cut costs?

- How did gaining control of the process improve their prospects of earning revenue in the future?
- How did gaining control of the process help them to develop new products?
- How do you think gaining control of the process would help them to retain their best staff in the future?
- How could gaining control of the process help in their relationships with suppliers?

And so on.

At each question emphasize the multiple benefits of having an efficient and predictable process. Try and finish up each discussion with a clearly strategic consequence. This helps with the next question.

**Question 3 –SPC is an operational-level technique of ensuring quality conformance. How many of the benefits of bringing the plant under control would you class as strategic?**

If the previous question has been thoroughly discussed, it will become evident that there are several strategic level benefits from process control. For example,

- A lower cost base
- Security of future demand
- Enhanced customer relationship skills
- Enhanced staff retention
- Better in-house product development
- A firm basis for continuous improvement
- The ability to form partnerships with suppliers

The diagram below can be used to make this point. Note how, in the centre of the diagram, 'gaining control of the process' is a very operational issue. However, the consequences of this on the outside of the web of consequences are all very strategic.



