Module 3

Processes and products

Outcomes

Upon completion of this module students will be able to:

- *Distinguish* between value-adding and cost-adding processes.
- *Describe* process thinking and the strategic importance of process.
- *Describe* the perfect process.
- *Perform* statistical process control calculations.
- *Describe* the concepts of lean thinking.
- *Describe* various models for developing products.
- *Explain* the relationship between uncertainty and risk in product development together with robust design and participative product development.
- *Define* quality and the characteristics of a total quality management programme.
- *Discuss* various quality management frameworks.
- *Discuss* process capability and six sigma quality.

Unit 5

Designing processes

Outcomes

Upon completion of this unit students will be able to:

- *Analyse* the service-profit chain
- *Identify* value in a process
- *Distinguish* between value-adding and cost-adding processes
- *Describe* the strategic service vision
- *Identify* the characteristics of service operations
- *Develop* strategic decisions for process
- *Describe* the product-process matrix
- *Describe* the process industries.

Activity 3.1

Activity

Work through the following list of customer classifications (Johnson & Clark, 2008, p. 58) and try and link each one with a person you know or have met in the past.

Title	Description	Your example
Ally	Arrives in a positive frame of mind, willing to help and provide feedback to facilitate a better service. The happiness of the ally rubs off onto other customers who believe the service must be good.	
Hostage	This customer feels "locked in" contractually and requires the service but has no choice or has a potential financial penalty if he/she goes elsewhere.	
Anarchist	Simply dislikes rules and systems and will object to being told to do something, or will get upset at having to fill in forms without any rhyme or reason.	
Patient	This is the type of customer who already belongs to the organisation and feels they have little chance of escape.	
Tolerant	Will quietly sit and wait for service. They may be passive and are usually ignored. They may not jump up and down and demand immediate service that other customers demand. They will sit quietly and wait.	
Intolerant	Will not sit quietly and wait. They often cause stress and problems. The intolerant customer makes their presence and requirements known. They may not be very clear or even coherent in describing what they want, but they will make sure that	

	supply service staff are handling their problem.	
Victim	This is the recipient of a product or service when something goes wrong. They seem to attract bad luck. The process fails and for some reason the victim just happens to be the customer. It is hard to predict exactly how a victim will react.	
Terrorist	Mounts a damaging attack when you least expect it. The terrorist is a real danger as they will strike without warning and inflict as much damage as possible. They will announce their displeasure knowing other customers are listening.	
Incompetent	This customer is confused by procedures. Often the incompetent will be a first-time customer and simply does not know what to do. They may stumble around looking for answers and may do irreparable damage as they go.	
Champion	Is supportive, helpful and positive. The champion is more than an ally and goes out of their way to be helpful, co-operative and friendly. Every organisation needs champions.	

Activity 3.1 feedback

Activity 3.1 required you to think of your own examples of customer types.

Activity 3.2

Activity

Work through the following questions. You may need to go back and reread the unit to help you.

1. Describe the strategic importance of process design.
2. Discuss the concept of process value.
3. Distinguish between job shop, batch, repetitive and continuous processes.
4. Describe the service-profit chain.
5. Distinguish between cost-adding and value-adding processes.
6. Discuss the impact of technology on process design.
7. Describe process flow scheduling.

Activity 3.2 feedback

All answers are in the learning material.

Unit 6

Improving processes — lean thinking

Outcomes

Upon completion of this unit students will be able to:

- *Describe* the strategic importance of process.
- *Describe* process thinking.
- *Prepare* process flow diagrams.
- *Identify* process variability.
- *Describe* the perfect process.
- *Describe* the steps for process improvement.
- *Describe* and use the seven basic tools of quality.
- *Describe* the concepts of lean thinking.
- *Apply* lean thinking ideas to services.

Activity 3.3

Activity

Make a list of two or three processes you are familiar with or choose an example below. Write down the input variables, the uncontrolled transformation variables, the controlled transformation variables and the output variables.

You may choose any process, but here are a few suggestions:

- An order being received from a customer.
- A house being built as a “spec build” (that is, built before a customer signs the order to buy it).
- A sports team being chosen.
- A letter being posted and delivered.

Activity 3.3 feedback

Consider an order being received from a customer:

- Variable inputs include the method of order receipt (email, fax, postal service, telephone, sales representative, customer service representative), the completeness of the order and the accuracy of the order.
- Controlled process variables include the amount of training given to the person receiving the order, the amount of

inventory on hand, the shipping methods available and the delivery date promised.

- Uncontrolled process variables include the attitude of the person taking the order, the day of the week, the season of the year, the customer-required date, the shift and the service team.
- Process output variables include the correctness of the order, the delivery time and the package quality.

Activity 3.4

Activity

Make a list of the steps you would introduce to an organisation that was implementing a lean thinking approach to production.

Compare your answers to the model at the end of the module.

Activity 3.4 feedback

The activities in a lean environment include:

- Developing strategies for dealing with highly variable demand.
- Focusing on reducing variability and reducing the impact of variability on production.
- Levelling the schedule for both volume and mix.
- Creating a flow of products that supports the drumbeat of expected customer deliveries.
- Monitoring customer order patterns and validating daily production.
- Producing to customer orders whenever possible at the exact day's mix using load-levelling techniques.
- Driving improvement activities so all processes can produce smaller quantities at shorter intervals.
- Creating a true mixed-model schedule as well as more repetitive demand for components being pulled from upstream processes.

Activity 3.5

Activity

Work through the following questions. You may need to go back and reread the unit to help you.

1. Discuss the strategic value of lean thinking.
2. Describe the seven wastes.
3. Describe the perfect process.
4. Discuss lean thinking applied to services.
5. Discuss process variability.

Activity 3.5 feedback

All answers are in the learning material.

Unit 7

Product design

Outcomes

Upon completion of this unit students will be able to:

- *Describe* the Kano model.
- *Explain* how the voice of the customer should be used in product design.
- *Explain* quality function deployment.
- *Discuss* structured product development processes.
- *Explain* the relationship between uncertainty and risk in product development.
- *Describe* the product development portfolios.
- *Explain* robust design.
- *Explain* participative product development or concurrent engineering.

Activity 3.6

Activity

Think back a few years when mobile phones that take digital photographs were introduced. Consider who wanted one. Designers introduced a “wow” factor that truly caught the imagination of millions of customers worldwide.

Now put yourself on the design team of the early models. What would you do first? How would you introduce this product?

What features would you include/exclude?

How would you sell the concept and convince people of the benefits?

Activity 3.6 feedback

With this activity you were asked to imagine yourself as part of the design team that developed mobile phones that take photographs.

The primary function of the mobile phone is to make and receive phone calls. However, with products like this, the marketing function may often try to develop a “wow” factor (this is a feature or a characteristic of the products that really catches the

imagination of the customer and makes it imperative that the customer purchases the product).

This definitely happened with the camera feature on mobile phones. It is hard to say exactly what should be done first since each example may provide a different set of circumstances and thus a different end result. Definitely two things have to happen: the technology has to work and the customers have to recognise a need for the particular feature and demand the feature.

The introduction of the feature is usually in a test market or to a group of friendly customers who can provide feedback on why they like it or why they do not like it. This introduction phase also provides valuable information that the marketing function will need when the feature is launched across more markets or to more potential customers. The duration of this introduction and market testing may take several months or even years depending on how well the feature is accepted and how the technology develops.

Think of these ideas when you read the next section of the course on Kano models and voice of the customer.

Activity 3.7

Activity

Use the **house of quality model** for the design of a laptop computer.

1. Start by making a list of customer requirements that will form the demanded quality hierarchy. Customer requirements state in customer terminology exactly what the customer wants with their laptop computer. List five-to-eight features a customer might want from their laptop computer.
2. Then list the quality characteristics that constitute the technical response to the demanded quality. This will be a list of five-to-eight design attributes the designer would incorporate in the laptop computer. Use generic terms such as “display type” and “memory type”.
3. Prepare the relationships matrix relating the demanded quality hierarchy with the quality characteristics hierarchy. For each entry in the demanded quality hierarchy indicate whether or not the quality characteristics have answered the customer need. For this activity just use general terms such as “yes”, “no”, “somewhat” and “mostly”.
4. Develop the quality planning table or competitive assessment which provides a qualitative benchmark comparison with other products, solutions and methods. To do this, imagine you have two competitive products in the market. They are A and B and your product is designated X. Now, for each demanded quality characteristic, rank the three products by how well they answer the customer need. (Note, this is purely hypothetical since you do not have the details of the competitive products.)
5. Construct the design planning table with the target values the design team is trying to reach. To do this properly you would need to be a designer with computer design skills. For this activity, this is not necessary. Just quantify each quality characteristic.
6. Finally, consider the correlation of technical requirements to support or impede product design. Do this by evaluating the quality characteristics for compatibility and non-compatibility.

Activity 3.7 feedback

1. The list of customer requirements that will form the demanded quality hierarchy for the laptop could include:
    - light weight (less than 2 kg)
    - small size (fit in briefcase)
    - long operation between recharging (last for one day's usage)
    - large keys on keyboard (enter data with big fingers)
    - short time to recharge (less than two hours)
    - readable screen (even in full sunlight)
    - durable (unbreakable)
    - fast processor/large memory capacity.
2. The list of the quality characteristics that constitute the technical response to the demanded quality might include:
    - case material
    - battery type and size
    - screen size and type
    - RAM memory
    - hard drive type and size
    - keyboard type and size.
3. Prepare the relationships matrix relating the demanded quality hierarchy with the quality characteristics hierarchy. At the intersection between each entry in the demanded quality hierarchy and each entry in the quality characteristics we have entered a Y for "yes", an N for "no", an S for "somewhat" and we have not used "mostly". In cases where the relationship does not exist we have left blank.

	Quality characteristics					
Demanded quality hierarchy	Case material	Battery/type/size	Screen type/size	RAM memory	Hard drive type/size	Keyboard type/size
Light weight	Y	N	Y	Y	Y	Y
Small size (fit in briefcase)	Y	N	S		Y	Y
Long operation between recharging		Y				
Large keys on keyboard						Y
Short time to recharge		N				
Readable screen			S			
Durable (unbreakable)	Y		Y		Y	Y
Fast processor/large memory capacity				Y	Y	

4. Develop the quality planning table or competitive assessment which provides a qualitative benchmark comparison with other products, other solutions and other methods. Two competitive products are marked A and B and your product is marked X. For each demanded quality characteristic, the three products are ranked by how well they answer the customer need. (Note, this is purely hypothetical since you do not have the details of the competing products.) A joining line is created to show your product X.

	Quality characteristics								
Demanded quality hierarchy	Case material	Battery/type/size	Screen type/size	RAM memory	Hard drive type/size	Keyboard type/size			
Light weight	Y	N	Y	Y	Y	Y	A	X	B
Small size (fit in briefcase)	Y	N	S		Y	Y	A	X	B
Long operation between recharging		Y					X	A	B
Large keys on keyboard						Y	B	A	X
Short time to recharge		N					B	A	X
Readable screen			S				X	B	A
Durable (unbreakable)	Y		Y		Y	Y	B	A	X
Fast processor/large memory capacity				Y	Y		A	B	X

5. The design planning table will have the target values that the design team is trying to reach and this is written in the basement part of the house. We have not included these values since this requires technical computer design skills

6. Finally, the correlation of technical requirements to support or impede product design does not, in this case, suggest any negative correlation.

Activity 3.8

Activity

Work through the following questions. You may need to go back and reread the unit to help you.

1. How is the problem of technology choice related to process selection and product design?
2. How much detailed technical knowledge on the part of managers is required to make a decision regarding selection of computer hardware?
3. Suppose you need to select a computer terminal to use in your office. What performance characteristics of the technology would you assess? How would you get the necessary information to make the decision?
4. What is the main obstacle to using a manufacturing approach to the delivery of services?

Activity 3.8 feedback

1. How is the problem of technology choice related to process selection and product design?

   Technology choice has a significant effect on process selection and product design. Technology choice is sometimes called manufacturing geometry and, in simple terms, means the combination and sequencing of production machines and the labour requirements to make it all happen.

   So, if we have a fully automated line with robotic machines, the product has to be capable of being made and assembled using automated lines and robots.

   If the product is to be produced using human labour with little or no automation, the process design has to be designed so as to minimise the labour effort.

   Technology choice decision is usually made first, followed by process selection and product design. Simultaneous engineering (or concurrent engineering) is the term applied to the simultaneous design of process and product.

2. How much detailed technical knowledge on the part of managers is required to make a decision regarding selection of computer hardware?

Strict technical knowledge is not required, but the manager needs to ask questions and be assured that the answers are satisfactory. Often with technical products (such as computers) managers are afraid to ask questions because it makes them look stupid. The reality is that managers should ask all the questions and insist on satisfactory answers.

3. Suppose you need to select a computer terminal to use in your office. What performance characteristics of the technology would you assess? How would you get the necessary information to make the decision?

   For an exercise like this you should develop a checklist and make sure the essential items on that list are being addressed. If you have used a computer terminal before you probably have some idea of the requirements. If not, you should check with people who have used a computer terminal in similar circumstances to your planned usage.

   Typical characteristics relate to hardware properties and software capability, the type of technology proposed and technical issues such as screen clarity, definition, colours, reliability, service and so on.

4. What is the main obstacle to using a manufacturing approach to the delivery of services?

   In most cases in this course we have not made a distinction between manufacturing and services because the general principles of operations management can be applied to both. With manufacturing, the output is usually tangible, the customer is not present during production, the product is produced and then consumed and any errors can be corrected before the customer is aware an error has occurred. The opposite applies to services because the output is usually not tangible, the customer is often present during the production phase, the product is often produced and consumed simultaneously and the customer is present when errors occur.

Unit 8

The concept of quality

Outcomes

Upon completion of this unit students will be able to:

- *Define* quality.
- *Define* the characteristics of a total quality management programme.
- *Discuss* the four traditional categories of quality costs.
- *Distinguish* between inherent capability and capability to meet specifications.
- *Explain* the process capability ratio C_p.
- *Explain* the process capability index C_{pk}.
- *Discuss* six sigma quality.
- *Explain* the concept of design for six sigma.

Activity 3.9

Activity

Classify the following costs as:

- external failure costs,
- internal failure costs,
- appraisal costs, or
- prevention costs.

Activity 3.9 feedback

Example	Type of cost
A manufacturer realises that there is a potential fault in their products and issues a product recall to correct it.	External failure cost.
Purchasing works with suppliers to ensure the required standard of raw materials are delivered.	Prevention cost.
Testing equipment is maintained for accuracy.	Appraisal cost.
A production run produces product that	Internal failure cost.

Example	Type of cost
does not meet specification and has to be run again.	
A customer claims a replacement product while under warranty.	External failure cost.
A staff training course is run to introduce new procedures.	Prevention cost.
A sample is tested and the incorrect measurements taken, so another sample has to be tested.	Internal failure cost.
Inwards goods are inspected on arrival to ensure they meet specification.	Appraisal cost.
Reject material has to be disposed at a hazardous materials dump.	Internal failure cost.
A new product is designed so that it can easily be manufactured with current equipment.	Prevention cost.
A customer tells a friend they have received poor service from a firm and discourages the friend from using that service.	External failure cost.
A new production process is tested to ensure it is capable of meeting specification.	Appraisal cost.

Activity 3.10

Activity

Calculate the process capability for the following examples:

If specifications say the oven temperature must be 175 ± 5°C and the standard deviation of temperature readings is 0.9°C. Calculate C_p.

If specifications say the oven temperature must be 175 ± 5°C and the standard deviation of temperature readings is 0.9°C.

Calculate C_{pk} if currently the process mean is 177°C.

Activity 3.10 feedback

$$C_p = \frac{\text{Upper Tolerance Limit - Lower Tolerance Limit}}{6\sigma}$$

$$= \frac{(175 + 5) - (175 - 5)}{6 \text{ x } 0.9}$$

$$= \frac{180 - 170}{5.4}$$

$$= 1.85$$

The closest tolerance limit in this example is the upper tolerance limit (175 + 5 = 180)

$$C_{pk} = \frac{\text{Upper Tolerance Limit - the current process mean}}{6\sigma}$$

$$= \frac{(175 + 5) - 177}{3 \text{ x } 0.9}$$

$$= \frac{3}{5.4}$$

$$= 0.56$$

Activity 3.11

Activity

Work through the following questions. You may need to go back and re-read the unit to help you.

1. What is quality?
2. Are the traditional costs of quality appropriate in today's business environment? Explain your response.
3. Explain process capability.
4. Explain how six sigma quality could be used by an organisation to improve its competitive position.

Activity 3.11 feedback

All answers are in the learning material.

Assignment 2

Assignment

There are four questions in this assignment.

Question 1 50 marks

Cole & Sons Shoemakers Co. Ltd. is a shoemaking company established by the entrepreneur, Edward Cole, in the 1950s. The company has been designing and producing leather shoes and supplying them to various retailers including specialty shoe stores and department stores throughout the country for nearly 60 years. In the early 1970s, the business went through a major change in its operations. David and John Cole, Edward's two sons, introduced changes which has led the company into rapid diversification (also producing sports and leisure shoes) and growth from a localised shoe producer into a major player in the global shoe market.

However, the core vision and direction of the company has not changed. It remains a high-volume, low-customisation shoe producer whose aim is to minimise costs. Also, Edward (as an entrepreneur) always believed that if you keep a high level of inventory, you can minimise dissatisfaction from customers.

About a year ago Edward retired, and David (a natural leader with excellent interpersonal skills) assumed the position of president, while John (skilled in operations management) remained as director of operations.

The brothers always dreamed of radically changing the company's operations style to better suit the needs for survival in today's business environment (they started by changing the name of the company into Sneakers.com). One day, John approached David and suggested the change of their operations into a lean thinking (just in time production) environment.

Help John explain the theory of lean thinking to David (assuming David has no explicit knowledge on this topic) in a simple way. Enhance your explanation with an appropriate analogy or example.

Answer to Assignment Question 1

Cole & Sons Shoemakers Co. Ltd.

John should explain to David that lean thinking as a philosophy of operations:

- eliminates waste
- involves everyone
- seeks continuous improvement.

John should explain to David that lean thinking is a set of techniques for managing operations, including:

- basic working practices
- design for manufacture
- operations focus
- small simple machines
- layout and flow
- total productive maintenance
- set-up reduction
- total people involvement
- visibility
- JIT supply.

John should explain to David that lean thinking as a method of planning and control has:

- pull scheduling
- Kanban control
- levelled scheduling
- mixed modelling
- synchronisation.

Question 2 30 marks

"The only acceptable performance is zero defects." Discuss the application of that phrase to each of the following situations:

- surgeons performing elective surgery
- builder constructing a house
- machinists fabricating automobile engines
- lawyers defending accused child molesters
- grocers stocking the supermarket deli display
- investment counsellors giving financial advice
- police officers apprehending a suspect
- Inland Revenue Department (government tax collection) recording tax payments
- merchants selling exercise equipment
- students completing an assessed assignment.

Answer to Assignment Question 2

All except the last one: Expect students to demand error-free performance from surgeons, lawyers and other professionals. A builder building a house may allow the owner to occupy the dwelling and make minor corrections as faults are discovered. In larger construction projects a contingency is often held back (sometimes 10 per cent) to use as a lever for satisfactory project completion. Police officers must go “by the book”, and exercise equipment merchants must exhibit honest sales tactics.

On the last one, however, students hedge a bit as their own performance is called into question. We've started lively class discussion by posing the question, “If zero-defect performance is so important when you consume goods and services, why aren't you willing to provide it?”

Question 3 10 marks

How do you determine quality in products?

For example, how do you distinguish a good car (or piece of furniture, garment, medicine or golf ball) from a bad one? Does the item’s price influence your thinking? What are society’s beliefs regarding a relationship between price and quality? Are these beliefs realistic?

Answer to Assignment Question 3

This exercise begins with the appearance of an individualistic response, then turns to direct student attention to the price/quality relationship. Generally, society believes there is a positive correlation between the price of an item and its quality. When we have nothing else to use as a “measure” of quality, we often look at its price relative to that of competing brands and infer the level of quality.

In examining the degree to which these beliefs are realistic, we must ask two questions:

1. Does the price reflect cost of manufacture or simply more profit on low-cost items?
2. What is the true quality/cost relationship? Increasingly, evidence suggests that high quality costs less to produce, not more.

Guide to markers: It is difficult to pre-assign marks to this question since we are looking for an appreciation of what quality actually is. So we are looking for a convincing argument.

Question 4 10 marks

How do you determine quality in services?

For example, how do you distinguish between a good lawyer (or accountant, lecturer, athlete, hairdresser or surgeon) from a bad one? Does the service price (fee charges or salary received) have any influence on your thinking? Does society pay the same attention to price when judging the quality of services as it does in the case of goods? Why or why not?

Answer to Assignment Question 4

We've directed student thinking to the price/quality relationship. For services, there is evidence of an even stronger belief that high price denotes high quality. With services, we've less to measure and therefore tend to rely more on surrogate measures such as price.

Guide to markers: It is difficult to pre-assign marks to this question since we are looking for an appreciation of what quality actually is. So we are looking for a convincing argument.