

MANUFACTURING ENGINEERING TRIPOS PART II B

Thursday 26 April 2012 9 to 12

PAPER 2

*Answer not more than **four** questions.*

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

Answers to questions in each section should be tied together and handed in separately.

There are no attachments

STATIONERY REQUIREMENTS
Single-sided script paper

SPECIAL REQUIREMENTS
Engineering Data Book
CUED approved calculator allowed

You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the Invigilator

CRIB

CRIB: QUESTION-1

a) A marketing plan would assume to have already have a business plan development in place, such as development of the following questions and answers in order to feed into the marketing objectives and planned development:

Business plan:- components

- Mission – “*What is our purpose?*”
- Audit (internal/external) – “Where are we now?”
- Objectives or Goals – “where do we want to get to?”
- Strategy – “How might we get there?”
- Tactics – “What is our plan?”
- Resource requirements – “what do we need”
- Controls – “What check are in place and what feedback exists?”

The Marketing Planning Components would consider the following, components and the sequence.

Marketing Audit
 SWOT Analysis
 Assumptions
 Marketing objectives and strategies
 Test alternatives
 Forecasts & Budgets
 Measurement & Review

Key Assumptions: could include:

- Average price of goods
- Total sales turnover prediction
- Cost of sales & overhead costs
- Gross Profits and Net Profits
- List all your Key Performance Indicators

Marketing Objectives would include

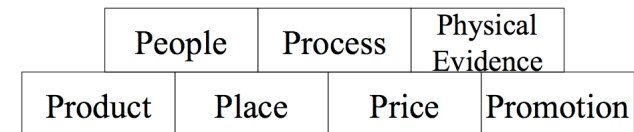
- Ansoff Matrix
 - Existing products in existing markets
 - Existing products in new markets
 - New products for existing markets
- New products for new markets

b) A Brand Strategy would encompass an analysis of the 4/5 Ps

- The Primary Marketing Levers
 - Price/Profit**
 - Product**

- Place**
- Promotion**

Collectively known as the **Marketing Mix**, which could be expanded to include an extended marketing Mix

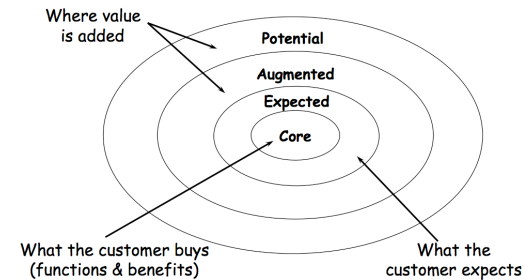


Extended Marketing Mix.

The **product** information includes:

- The tangible products
- Brand, design, quality, features and packaging
- Service, delivery and installation, guarantees, credits and terms

Creating a superior offer to achieve customer preference



The **Price** Information includes:

- Cost-plus strategy
- Demand based pricing
- Product-line pricing
- Marginal pricing
- Competitive pricing

- Life-Time pricing

The **Place** information includes:

- Right place for product
- Right place for target market
- Sufficient area coverage
- Managing channel conflict

The **promotion** information includes

- Includes all communication about product
- Advertising & PR
- Exhibitions
- Publicity materials
- Packaging
- Direct marketing
- Important to measure value added to business*

In summary, an effective marketing strategy requires:

- A complete understanding of the customer and needs including his own market
- Customer orientation at least as strong as technical orientation
- An appreciation of the sources of uniqueness in industrial marketing
- An understanding of the organisation’s strengths and weaknesses and a matching of these to customer needs
- An integration of the components of marketing strategy to yield unique competitive advantage through differentiation

Examiners Comments

Module: Strategy & Marketing

Number of Attempts: 26

Average: 65

Standard Deviation: 11

A popular question answered by 72% of the class that was developed from the Strategy and Marketing module, with the main emphasis in this case on marketing and brand strategy. Most candidates were able to describe the essential elements of a marketing plan, though many failed to cite the significance of the business development plan that provides the foundations for the business linked marketing strategy. Nearly all candidates were able to identify the marketing planning components, and the key assumptions necessary for a comprehensive analysis. Reasonably comprehensive answers to part b were offered by most candidates, although marks were usually lost for wordy descriptions that lacked detail. Good answers used graphical means to describe the primary or extended marketing levers, with detailed discussion of the individual elements.

QUESTION 2 CRIB

(a) Good leaders can affect positive change by:

- Articulating a clear and compelling vision
- Explaining how the vision can be attained
- Empower people to achieve the vision
- Acting confident and optimistic
- Expressing confidence in followers
- Securing early success
- Celebrating success
- Leading by example – actions speak louder than words

Leaders must ensure they do not lose sight of the people who deliver their vision.

They must consider how others might interpret change (as individuals).

They must also consider that might motivate individuals to embrace change.

(b)

There are three types of change:

- Developmental, or incremental change would be associated with continuous improvement programmes, building on and improving existing practices (students should draw on the lessons learnt from the lecture given by Andrew Hawes, Newton).
- Transitional change would involve the introduction of new practices, which are well understood, for example, lean manufacturing or six sigma implementation (students should draw from the lecture given by Chris Owen, SMMT).
- Transformational change involves taking a completely new approach to the organisation’s activities, or some part of them, the outcome of which is not fully understood, for example merging with another organisation (students should draw from Gary Ashton’s lecture on partnerships and people).

Resistance to change will depend upon the individual’s interpretation of the change and its impact upon them, influenced by e.g:

- Its effect on the intrinsic nature of the work
- Its effect on the amount and direction of discretion, power and autonomy
- The organisational context (trust of managers/firm)
- The manner in which it is introduced
- The perceived balance of cost and benefits
- Underlying tension (long standing disputes aired as part of change process)
- “That’s the way we have always done it”

Managers can deal with resistance to change by recognising and understanding the reaction to the change. The key steps include:

- Education and Communication
 - When there is a lack of information & analysis
 - The change managers should make sure they understand the current situation clearly and have all the data and facts at hand to communicate the need for change.
 - Managers should have a clear vision, belief, and path for the change, and must communicate it to all involved in the change.
- Participation and Involvement
 - When initiators do not have all necessary information & others have power to resist
 - Empathy is key to influencing people to bring about change. This involves understanding the concerns of different parties involved in the change process, involving them in the design of the change process, and making sure their concerns are addressed.
- Facilitation and Support
 - Where resistance largely reflects problems of adjustment
 - Managers need to ensure necessary training and support is provided to employees where the change affects their work processes.
 - Training should aim to bring about the change and ensuring that the change is sustained.
- Negotiation and Agreement
 - Where one or more powerful parties will lose from the change
- Manipulation and Co-option
 - Where other factors will not work or are too expensive
 - Managers should be careful in using this as it may backfire if the employees realise that they are being manipulated.
- Explicit and implicit coercion
 - Where speed is essential and initiators have considerable power
 - Should be used only as a last resort

Good responses will draw from examples and situations discussed during various lectures in the module.

Examiners Comments

Managing People

Number of Attempts: 33

Average: 67

Standard Deviation: 8.9

A very popular question answered by 91% of the class that was developed from the Managing People module, with the main emphasis in this case on the essence of leadership and the process of managing change. The question was answered well on the whole, with higher marks awarded for well planned and executed arguments, and the use of supporting diagrams. Most candidates were able to explain the role of leaders as change agents, although high scoring candidates were able to give good examples from either their own experiences of case studies from the lectures. Nearly all candidates were able to describe the major reasons for resistance to change, although supporting

evidence from case studies received higher marks.

QUESTION 3 CRIB

Strengths and weaknesses:-

Rather like the UK and Germany in the 1950s, South Korea now and Japan a decade ago have become the nations they are because of a phenomenally hard working generation with an essentially traditional family structure of the man working and the woman running the home. In each case they have drawn understanding from abroad and copied and learnt energetically, and become major players in various global industries, earning income by exporting strongly. In Japan it has been primary processing – steel making, carbon fibre, chemicals, machine tools of all kinds – and then product manufacturing in numerous industries – ship building, cars, aircraft components, nuclear power plant, electronics, electrical/digital and computer goods. In South Korea there has not been the same development of primary processing, but significant success in product manufacturing – ship building, cars and electronics, electrical/digital and computer goods, taking over leading global positions from Japan in some aspects of these industries.

What have been strengths also create weaknesses, in that both countries sustain highly competitive education systems somewhat based on rote learning, so that they are highly productive but not highly creative. This is linked to significantly hierarchical social structures which on the one hand create fierce loyalty but on the other require very high quality leadership, which, if it fails, or becomes corrupt, demolishes its own foundations, as has been visible in Japan for two decades now. A more serious problem in both countries is that it has generated very low birth rates, well below replacement rate, and thus both countries have seriously aging populations and have shrinking (Japan) or soon to be shrinking (South Korea) populations, still with strongly traditional family structures. The rising generation thus has a heavy burden to carry in both cases, made worse in Japan by the recent devastation of the tsunami and the nuclear disaster and more generally in South Korea by being half of a split country that, at some point, has to become reunited. Neither country is blessed with large quantities of natural resources and so they have to earn their place in the international network by their manufacturing skills. Out-and-out innovation is not their strong point.

Opportunities and threats:-

Quite unlike South Korea, Japan has managed, over the years, to export not only products but also technology and production methodology to the world, and many Japanese companies have production facilities all over the world. This international spread gives Japanese industry a wealth-creating labour base that can help sustain Japan's aging population, via a continued global spread of Japanese management. Continued Japanese manufacturing of key components at the heart of otherwise western products, such as the Boeing Dreamliner, also maintains a Japanese manufacturing base

at home. A seemingly weakening position in electronics and computer goods does not look so good however. Machine tools appear to continue to grow, but heavy industry to decline.

South Korea has a world position in certain products – shipbuilding, electronics and cars, for instance – but not in the spread of technology and managerial understanding, giving a more introverted appearance. This is a harder base to grow from. South Korea perhaps needs to seek out more niche businesses, smaller and more nimble in world markets than mass production. This is particularly skill driven and also communication driven, and perhaps requires well-developed collaboration with more creative countries, such as the design capability in countries like the UK. They are developing a relationship with Germany in wind energy technology, which is an example of this, but is still importing know-how, not exporting it.

Growth strategy

Japan appears to have much to do to re-grow its internal integrity of leadership. Large manufacturing companies still appear to be faltering (e.g. Sony) and lack of accounting transparency draws significant criticism. These are internal behavioural faults that need moral rather than technical work to be done, to re-grow a valuable society. With the tsunami and the nuclear disaster, there is significant internal technical focus that could become the focus for this both moral and technical rebuilding. It needs strong leadership.

South Korea continues to be technically very successful and in a direct sense very productive. A strongly hierarchical social structure can work well within a country, but does not necessarily transfer well into good management overseas. The development focus perhaps needs to be on creative relationships, on developing more outward contacts and collaborations that increase communication and interchange. Relationship competence is going to be the biggest need when North Korea finally opens up. Having strong – vibrant – international involvement as a culture as well as an industrial producer will be very important. Goods alone are not enough.

Examiners Comments

Overseas Research Project
Number of Attempts: 7
Average: 74
Standard Deviation: 6.9

A very unpopular question answered with only 19% of the class choosing to answer this question that related to the locations for the ORP study tour. A surprising set of responses given the very high average mark for this paper. It is clear that those students who took an active role in the study tour development programme, were able to glean sufficient information from this engagement, which, combined with their existing knowledge of these two far eastern economies, allowed them to develop comprehensive answers to the question. On the whole all candidates were able to provide discussions rich in detail, with some convincing arguments backed up by a range of statistics, and the ability to directly compare the two economies which made for some interesting reading.

Question 4 CRIB

The answers to these questions can all be found in Chapter 7 of Natural Capitalism, available at www.natcap.org:

Chapter 7: Muda, Service & Flow

A nearly universal antidote to wasteful practices is called "lean thinking", which puts the step-by-step elimination of waste (called muda) at its heart. The method has four interlinked elements: the *continuous flow* of value, as *defined* by the customer, at the *pull* of the customer, in search of *perfection* (which equates to the elimination of *muda*). This chapter hypothesises that waste, often designed into a manufacturing system in a poorly focused drive for efficiency, is the real enemy of efficiency when measured at a greater system level. The candidate should be able to give examples of how an attack on waste using standard manufacturing routines can also be used to identify and systematically remove environmental waste. Primary effects are the direct improvements e.g. using less energy at a machine level through turning it off at break times. Secondary effects are often felt at the system level e.g. the natural batching of operations in manufacturing to achieve cost efficiencies can result in the same material being heated, allowed to cool, re-heated at the next operation, etc, and a system that flowed would allow a useful condition to be maintained (hot material). The authors also introduce the concept of 'right-sizing' a production process by reference to the whole system and maintaining a flow across the industrial system.

Negative consequences should be argued from logic and knowledge of general lean thinking. For example, the small amounts of inventory held may lead to extra journeys of only half-loaded trucks, hence increasing energy used in transport; or the focus on flow and the maintenance of a robust process may mean that manufacturers keep their processes operating at too high a specification (using more energy than needed as a form of safety margin).

The authors argue that the ultimate delivery of customer value is embodied in what we do with products, rather than just in ownership of them (though not true for art, say). By seeking to design a business that delivers that value through selling the service we hold the potential to de-materialise that service. One example given is the sale of 'coolth' (cf 'warmth') whereby refrigeration equipment companies sell the service of keeping things cool, rather than selling refrigerators. The company can then invest in more efficient equipment than customers might typically buy, and save on energy bills, thereby generating greater profit and reduce environmental burden.

This concept of selling service is most attractive to companies with technological know-how on products that are wasted at end-of-life and/or use energy during their customer

use. Xerox copiers and Rolls-Royce engines are often quoted example and may be usefully used here.

Another useful example is chemical leasing e.g. whereby a chemical company offers to paint a car rather than sell paint. This incentivises them to find ways to use less paint while producing a good finish; a task that they have the technical competence to accomplish and now they have the incentive to use that competence.

Negative impacts should be argued logically. For example, customers may abuse a poorly-defined service (by lowering the temperature on the refrigerators for example, because they don't pay the energy bill anymore, or by handling equipment poorly because they feel it is not owned by them, hence reducing its working condition and increasing the need for maintenance & spares and the associated logistics).

Examiners Comments

Module: Sustainability

Number of Attempts: 22

Average: 66

Standard Deviation: 7

A reasonably popular question answered by 61% of the class that was developed from the Sustainability module, with the main emphasis in this case on *muda*. Most candidates were able to describe the essential elements of *muda*, and were able to place their arguments in an industrial context, whilst at the same time identifying areas where the drive for *muda* may not always be the best option for a sustainable manufacturing operation. Nearly all candidates were able to offer a wealth of industrial examples to support their arguments, with many choosing the two main cases of Xerox and Rolls Royce.

QUESTION 5 CRIB

Answer

This question draws on a number of concepts and management tools and techniques presented and discussed during the Technology and Innovation Management module.

- (a) Henderson's model of industry evolution (figure 1) is presented to explain how at the beginning of the evolutionary process there are many competing technologies and product designs. There may even be competing business models. This era of diversity and competition is described as the era of ferment – before the diversity reduces and a dominant design emerges. Examples are in the automotive sector (many different early designs and propulsion technologies for cars), personal computers (different operating systems) and typewriters (different mechanical design and layout) – and many others. The era of ferment is also the time of disruption for incumbent technologies/products/industries, as for example when the typewriter was replaced by the pc word processor.

Key framework: The industry life cycle

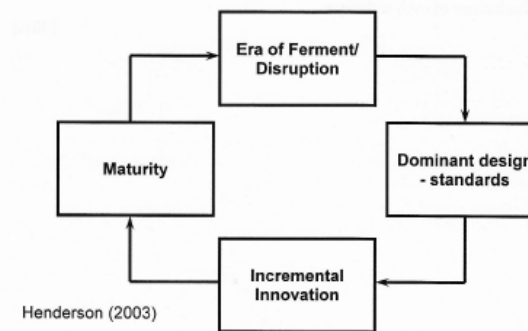


Figure 1: Industry evolution

- (b) The technology 'S' curve shows how technological performance changes over time, with accumulated investment and experience (figure 2). This concept links to the competitive impact of technologies and the concept of a lifecycle in this regard is also relevant (table 1). The important factor when using the 'S' curve is to be clear about the measure of performance that is relevant – as technologies may have many, and incumbents may be displaced by new technologies that initially perform worse on established criteria but offer

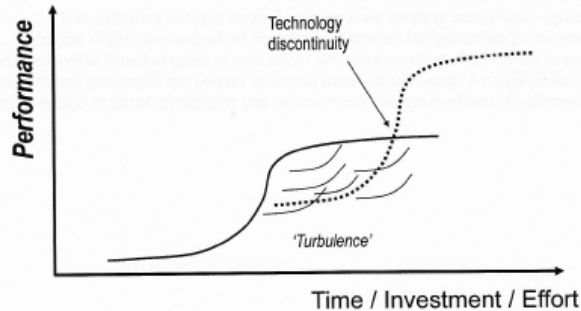
something new and attractive to the customer (for example the digital camera). Better answers may point out that the curve is best considered at industry aggregate level – within individual companies the curve may be more irregular.

Stage of technology maturity	Competitive impact of technology
Base	Essential to business Widespread Little competitive impact
Key	In use in product Basis of competitive differentiation High competitive impact
Pacing	Potential game changer Not yet, or only just, embodied in product Competitive impact likely to be high
Emerging	Early research Emerging in other industries Competitive impact unclear but promising

Table 2: Competitive impact of technology over its lifecycle

Good students will discuss how managers should track the performance of their significant technologies over time and be aware of the risk presented by new technologies appearing during periods of turbulence (ferment) when established technologies have reached maturity. Better students will discuss the difficulty of establishing appropriate performance measures, and the fact that the curve itself may be made up over many smaller curves if a longer time frame is taken. Despite these practical difficulties, an awareness of the risks represented in this concept will help managers to anticipate change.

Change and uncertainty



Adapted from Bower, J. L. and C. M. Christensen (1995). "Disruptive technologies: Catching the wave." Harvard Business Review January-February.

Figure 2: The technology 'S' curve

(c) There are several techniques that help managers to anticipate the impact of technological change. Technology roadmapping and technology intelligence gathering are two such approaches that were presented and discussed in detail during the module. Students should be able to explain these concepts, as shown in figures 3 and 4. Other possible (less relevant) techniques: scenario analysis, options analysis, QFD.

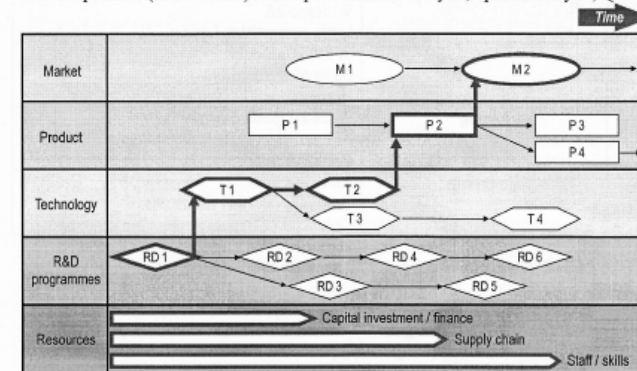


Figure 3: Technology roadmap

Technology roadmapping is the process to produce a time based chart showing the link between technological development, products and processes, and market and business conditions. It makes use of multi-disciplinary perspectives in developing the map, and hence it is the process and the decision support it provides, that is more important than the map which is never complete.

Technology intelligence systems are a means of organising the gathering and interpretation of technological information relevant to the business, while making good use of the limited resources available in the firm to carry out such activities. The framework in figure 4 shows the different activities carried out depending on whether the information is inside or outside the business, and whether its location is known or not.

Examiners Comments

Technology and Innovation Management

Number of Attempts: 36

Average: 65

Standard Deviation: 8.3

A very popular question answered with 100% of the class choosing to answer this question that related to the management of innovation. Part a) posed few problems on

the whole, with many students offer detailed discussions on the industry lifecycle, with the addition of industrial examples. Part b) gave good candidates chance to show their understanding the 'S' curve, and the performance measures necessary to assess a particular product. Part c) delivered a wider range of performance, with many students failing to give sufficient details on the method under discussion. Road Mapping was well understood on the whole, with slightly less understanding demonstrated when discussing technology intelligence systems.

QUESTION 6 CRIB

Question 6

This question draws on material presented in the first and last modules of MET 2 and is designed to elicit the characteristics of companies at different stages of evolution. Good answers will be expected to identify the following issues and ideally illustrate them with examples from the cases that were presented during the Modules.

For start-up companies good answers should:

- Identify the importance of identifying and scoping markets
- Specifying and managing design
- Developing or outsourcing production capability
- Establishing and managing capital and cash flows

The example of a competitor to Nespresso Coffee Machines was used in the course.

For high growth companies good answers should highlight:

- The need for highly responsive market monitoring and feedback
- The provision of access to scalable production capacity
- Identification of reliable sources of raw materials and parts
- Very close management of cash flow

The example of Innocent Drinks was used in the course.

For large-scale established businesses good answers should highlight:

- The importance of sharing good manufacturing practices across sites
- Exploiting opportunities for consolidation of supply to maximise scale benefits
- Regular review of "Make or Buy" decisions to take account of potential lower cost source options
- The capability of manufacturing and supply networks to cope with product and market variations

GSK was used as the example in the module.

Examiners Comments

Manufacturing Strategy, Policy

Number of Attempts: 21

Average: 64

Standard Deviation: 7

This question draws on material presented in the first and last modules of MET IIB and is designed to elicit the characteristics of companies at different stages of evolution. On the whole those candidates that chose this question (58% of the class) performed reasonably well, although there were few high scoring answers. Good answers were able to identify the issues relating to the three phases of manufacturing operations, for each of the areas requested. Candidates lost marks in not relating the issues discussed with sufficient background material drawn from case studies given in the lectures, or even from their own knowledge of corporate developments.

Examiner: Prof W. O'Neill

Sept 2012