Engineering Tripos Part IB, 2P8: Manufacturing and Management, 2017-18

Lecturers

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Timing and Structure

Easter Term: 12 lectures + 2 Industrial cases, 2 examples classes, 4 lectures/week.

Prerequisites

None

Aims

The aims of the course are to:

- Introduce the excitement of business development related to technology innovations.
- Cover the key choices facing anybody seeking to exploit the commercial potential of a technology based innovation – whether as an entrepreneur or acting within an existing business; however we can't promise to make you millionaires

Objectives

As specific objectives, by the end of the course students should be able to:

- Understand the likely stages of development from innovation to profit
- Design an appropriate exploitation route for the given innovation
- Describe the main features of how a business works

Content

Specific objectives are given for each lecture, and both the examples sheet questions and exam questions will be designed to test students learning against these objectives.

The lectures follow a series of key questions which represent the decisions that must be taken in finding an exploitation route for a technical innovation.

Where do inventions come from?

Inventions may arise from a spontaneous inventive step, a market demand, or a development of an existing idea. The purpose of this course is to explore the path from invention to business, but we start by examining the source of inventions and the conditions in which they are likely to occur. By the end of the lecture, given a perceived market need, students should be able to:

- list at least six strategies by which new inventions are found
- give at least one example for each strategy, and in the examples paper, think about how each strategy might apply in developing a new writing instrument

- describe the structure of this course

Is there a market?

Two major sources of invention are ‘push’ – the inventor thinks of something new and must establish a market; and ‘pull’ – there is a clearly defined market demand. In both cases, successful exploitation depends on understanding of the nature of the market and identifying precisely what the need of the users and customers are. By the end of the lecture, given a proposed new technology or concept, students should be able to:

- Apply the concept of the 'design mix' determine the key product attributes
- Map the whole market for this product, identifying viable market segments - to name clusters of like minded customers

What do the users want?

It is important that any design meets the requirements of potential users, customers, and any other stakeholder who might be influenced by the design, from maintenance to distribution. There are a number of different ways in which these requirements might be captured and considered. By the end of the lecture, students should be able to:

- Identify the stakeholders who are influenced by the design
- Understand two distinct appraoches to understanding customer neds
- Apply the Kano model

From specification to concept

Usually the inventive step is not a whole product but some feature of a broader ‘package’ offered to customers. In the early stages of the design process, it is important to clarify the exact product proposal, and to create viable concepts that might satisfy user requirements. By the end of the lecture, given a target market and a clear understanding of user needs, students should be able to:

- Clearly specify what is needed
- Understand how to generate and trest concepts, including the role of prototyping
- Understand the importance of a design process

How will the product be made?

Having considered the idea, the relationships between the invention and the market, the protection of the idea and the ‘business model’ the product must now be made. This involves decisions about whether components are made ‘in house’ or ‘out-sourced’, how jobs should be designed for manual workers, and how to manage relationships with partner companies. By the end of the lecture, given a description of a product and a delivery system, students should be able to:

- Describe the reasons why it is both desirable and impossible to balance supply and demand and suggest some strategies for managing both
- Discuss the use of automated technology in designing a production system
- Describe the choices made by managers of a supply chain to ensure efficient collaboration

How can your ideas be protected? An introduction to intellectual property

Before any public disclosure of an innovation, an inventor must decide how to prevent competitors copying the new features. By the end of the lecture, students should be able to:

- understand what is meant by Intellectual Property
- understand the implications of different methods of protection by:

- trade marks

- copyright
- design right
- registered designs
- patents

How can your ideas be protected? More on patents and other aspects of IP

One method for protecting intellectual property is through a patent - but these are not as simple or as protective as is generally thought. By the end of the lecture, given a patent for an artefact or process, students should be able to:

- identify whether a patent may be an appropriate method for protecting an idea, and weigh up some of the advantages and disadvantages of this method
- understand the tests of novelty, usefulness and the inventive step which an invention must satisfy in order to be patentable
- appreciate the need for confidentiality before a patent application is filed
- understand the structure of a typical patent, especially the claims
- talk reasonably intelligently to a patent agent

How does the innovation make money?

This lecture focuses attention onto two related issues. Firstly, we examine and compare the different 'business models', i.e. the various ways in which your business can generate revenue. This is trying to address the question of 'What are you actually going to sell?' Secondly, we turn attention back to looking at who the customer really is for your idea (a theme highlighted in lecture 2) and link this to the business model. By the end of the lecture, you should be able to:

- List and compare the different types of business model
- Link the choice of business model to a clear understanding of who the customer really is

How to get investment?

Businesses need resources (people, equipment, consumables, etc.) to create value. Many new firms need external financial investment in order to acquire these resources. External financial investment comes in different forms from a variety of sources. The aim of this lecture is to provide an overview of these different types and sources of investment, and explain what entrepreneurs need to do to in order to acquire investment. By the end of the lecture, students should be able to:

- Compare the differnet types and sources of money available to start a new business
- Select the appropriate source of funding for different stages of the technology commercialisation process
- describe the basic sections of a business plan written to raise investment

How to work with other companies

Very few companies are able to create value by operating alone. Working in partnership with other businesses is a very common feature of innovation-based businesses. Partnerships can encompass joint development agreements, licensing deals, co-branding, market channel access, and many more. However, there are many management challenges that need to be overcome if partnerships are to deliver value to all partners. By the end of the lecture students should be able to:

- describe the motives for forming partnerships
- understand the different ways in which companies can work together
- appreciate some of the complexities of setting up and managing partnerships

Keeping ahead through innovation

Implementing one good idea is not sufficient to ensure the long-term survival of a company. Companies need to innovate if they are to continue to grow. In this lecture, we will review the different types of innovation – such as

product, process, service and business model – and the challenges of managing a portfolio of innovation projects in a growing business. By the end of the lecture, students should be able to:

- list the different types of innovation
- describe some of the challenges of managing a portfolio of 'old' and 'new' products/services
- compare the challenges of managing radical versus incremental innovations

Managing growth

As companies grow, new management challenges need to be addressed. For example, when a company has only a few employees who all know each other very well, decisions can be made quickly. As a company grows and has hundreds or thousands of employees, things get more complicated. In this lecture, we will examine the differences between the management of a start-up and a larger, long-established company. By the end of the lecture, students should be able to:

- compare the characteristics of a start-up versus,long established company
- describe some of the different managemnet challenges resulting from these different characteristics

Case studies

As a conclusion to the course, two external speakers – one high-tech start-up founder, one senior manager from a large multinational firm – will discuss their own experience of successful innovation, giving students the chance to test knowledge gained in the sessions against real experience.

REFERENCES

Cagan & Vogel, (2002), Creating breakthrough products: innovation from product planning to program approval, Prentice-Hall, USA

Goffin, K. and R. F. Mitchell (2010). Innovation Management: Strategy and Implementation Using the Pentathlon Framework, Palgrave.

Lang (2002) The High-tech Entrepreneur's Handbook: How to Start and Run a High-tech Company, FT.com

Moore, (1998, 2008), Crossing the chasm: marketing and selling technology products to mainstream customers, Chichester, Sussex.

Ulrich & Eppinger, (2000, 2004 and 2008), Product design and development, McGraw-Hill Higher Education

IfM Design Management Group
website: http://www.ifm.eng.cam.ac.uk/research/dmg/design-and-npd-management-tools/ [2]

Booklists

Please see the Booklist for Part IB Courses [3] for references for this module.

Examination Guidelines

Please refer to Form & conduct of the examinations [4].

UK-SPEC

This syllabus contributes to the following areas of the UK-SPEC [5] standard:

Toggle display of UK-SPEC areas.

GT1

Develop transferable skills that will be of value in a wide range of situations. These are exemplified by the Qualifications and Curriculum Authority Higher Level Key Skills and include problem solving, communication, and working with others, as well as the effective use of general IT facilities and information retrieval skills. They also include planning self-learning and improving performance, as the foundation for lifelong learning/CPD.

IA1

Apply appropriate quantitative science and engineering tools to the analysis of problems.

IA3

Comprehend the broad picture and thus work with an appropriate level of detail.

KU1

Demonstrate knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics.

KU2

Have an appreciation of the wider multidisciplinary engineering context and its underlying principles.

D1

Wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations.

D2

Understand customer and user needs and the importance of considerations such as aesthetics.

D3

Identify and manage cost drivers.

S1

The ability to make general evaluations of commercial risks through some understanding of the basis of such risks.

S3

Understanding of the requirement for engineering activities to promote sustainable development.

E1

Ability to use fundamental knowledge to investigate new and emerging technologies.

E2

Ability to extract data pertinent to an unfamiliar problem, and apply its solution using computer based engineering tools when appropriate.

E3

Ability to apply mathematical and computer based models for solving problems in engineering, and the ability to

assess the limitations of particular cases.

P1

A thorough understanding of current practice and its limitations and some appreciation of likely new developments.

P3

Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology, development, etc).

P5

Awareness of nature of intellectual property and contractual issues.

US1

A comprehensive understanding of the scientific principles of own specialisation and related disciplines.

US3

An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.

US4

An awareness of developing technologies related to own specialisation.

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