

## **2013 Manufacturing Engineering Part IIB Paper 2 Prof Bill O'Neill**

General Comments.

The METIB students have delivered examination returns that reflect their broad knowledge of the manufacturing value chain. In the case of this paper many candidates have demonstrated an excellent grasp of the operational management across modern manufacturing enterprises. In addition to requesting information on the detailed foundations of many operational practices, the candidates were encouraged to support their answers with real-world implementation of the management techniques by providing industrial examples. In many cases candidates were able to provide detailed examples through their own direct experience from project activities or information gleaned from taught modules.

### **Q1 Crib**

**a)**

Good answers will be expected to:

- Outline internal product development processes highlighting key stages of Concept/Seed Round, Product Development, Alpha/Beta Test, Launch/1<sup>st</sup> Ship.
- They should also describe the stages in understanding and preparing the market including Customer Discovery, Customer Validation, Customer Creation and Company Building.

**b)**

Good answers might be expected to outline one of the “standard” models – possibly ‘Business Model Canvass’ by Osterwalder and Pigneur addressing the following factors Key Partners, Key Activities, Key Resources, Value Proposition, Unfair Advantage, Channels, Customer Segments, Cost Structure and Revenue Streams.

**c)**

Good answers would be expected to highlight major differences in strategic options including resources for research and development, access to large markets, ability to rapidly scale up, opportunities to negotiate competitive supply costs, access to distribution channels and ability to provide service-based options.

Examiners comments. This question, answered by 25% of the class, was developed from the International Enterprise and Manufacturing Policy module, with the main emphasis in this case on the development of a new product for a startup company.

The wide-ranging answers resulted in a large standard deviation. There were some excellent answers that presented a thorough discussion of many of the major issues of NPD for startups. Lesser answers offered limited discussions, focusing on the NPD aspect without giving rise to discussions of the key stages of the development such as gauging the market, concept development, funding acquisition, product development and testing etc.

## Q 2

a)

Good answers would explain that brand development requires an understanding of current consumer wants and needs and:

- Determine the positioning in terms of product, place, price, promotion, people, processes and physical evidence.
- Test (preferably quantitatively) the potential impact of the proposed brand on the market perception of the product.
- Feedback brand testing information to product development and design.

b)

Good answers should:

- Link the brand characteristics as above to key manufacturing strategy by dimensions.
- Manufacturing strategy objectives, cost, quality, delivery and flexibility and levers production processes, supply chain.
- And structural and infrastructural dimensions of manufacturing strategy – Hayes and Wheelwright.

Discuss the possible interactions between these dimensions of a brand and manufacturing strategy.

c)

Good answers would expect to relate key industrial strategy dimensions including skills, research and technology, regulation, taxation and draw agreements to the structural and infrastructural manufacturing strategy as above.

- Provide examples of the impact of industry policies on specific industries.

Examiners comments. A reasonably popular question answered by 56% of the class that was developed from the Strategy and Marketing module, with the main emphasis in this case on the development of brand strategy. The question was answered well on the whole, with candidates able to detail the brand development with good examples. Marks were lost through failing to detail the quantitative testing of brand impact and particularly the need to feedback test data. Most answers provided a good account of manufacturing strategy, although marks were lost through a lack of discussion on the interactions between infrastructure dimensions and manufacturing strategy. Better performing candidates were able to provide examples of the impact of industrial policy on specific industries.

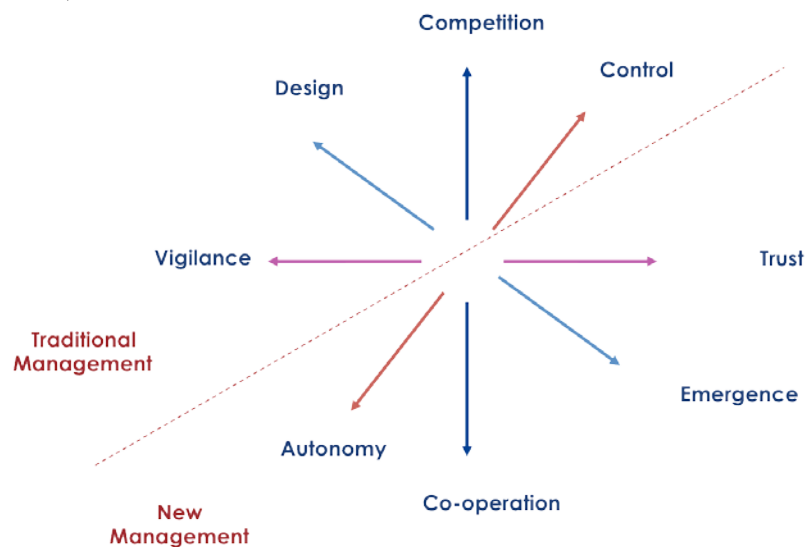
### **Q.3 CRIB**

Part a). The key problems that could arise when two business enter into a joint venture are:

- Clash of intentions
  - Profit vs Hi-tech product
  - Profit vs Customer delivery
  - Technology knowledge vs Low-tech high production
  - The JV as an end in itself vs JV as a means to an end
- Tensions also arise when
  - Overlapping capabilities
  - Mismatch in performance expectations
  - Misalignment between Parent and JV strategies
  - Importance of JV to Partner (Financial or Reputational)
- “Time changes everything”
  - Start-up & growth
  - Mature & steady
  - Change of circumstances / switch in partner strategy
- Supply chain interests affect the game
  - Supplier; sub-contractor; customer; competitor; owner
- JVs behaving badly
  - Unclear strategy
  - Cake-snatching rather than cake-growing
  - Negotiating everything
  - Closed / delaying bad news
  - Arguing about the money rather than dealing with the issue

Part b). Key to an effective partnership are:

- good business logic – driven by the business strategy of both companies underlying the partnership;
- good contract management – but understanding that the contract is only a safety net, which is rarely activated, used to handle residual risks, specifies rights and obligations of both partners, and aims to avert possibility of problems.
- good relationship management – developing and building trust is critical. Trust reduces complexity by increasing certainty and reduces cost of monitoring and enforcement.
  - Understand your own organisation
  - Understand your partners' organisations
  - Understand the relationship
- Effective partnerships need to reflect on their respective management styles (see figure below):



JVs work well when

- Lot of work on pre-agreement & joint strategy
- Open & transparent
- Consensus-driven
- JV has distinct identity & culture

Examiners Comments. A question answered by 44% of the class that related to the problems encountered by companies entering into a joint venture. Most responses were reasonably well answered with many answers capable of discussing the key problems that arise in JVs. Higher scores were obtained through the provision of industrial examples where JVs have been both successful and those that were

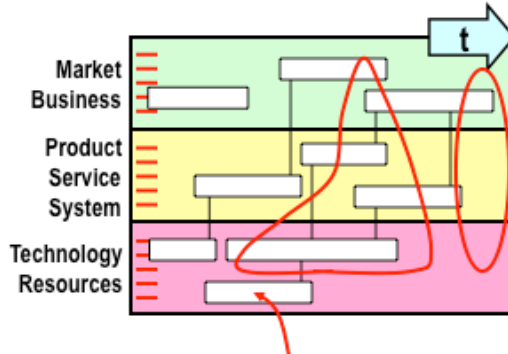
unsuccessful, thereby highlighting the elements that are required for effective partnerships. On the whole candidates were able to provide discussions in reasonable detail.

#### Q4 CRIB

(a)



(b) (i)



(ii)

*The process of developing roadmaps is as important as the roadmaps themselves, due to the associated communication and network-building benefits. The process needs to be customised to suit the context, along with the structure and format of the roadmap. Consideration should be given to how the first roadmap is developed and then also to how the roadmap can be maintained, to provide an ongoing reference point for communities of interest. Typically, for substantial sector level roadmaps it might take several months or more for a first good quality roadmap to be developed (suitable for publication). While the*

*particular approaches vary considerably, the use of workshops as a key ingredient is a common feature, owing to the communication and network-development benefits, building consensus about what the key issues of interest and concern are, and the actions that are needed to move forward. Two common activities are:*

*1. A large roadmap wall chart is used to share perspectives across the full scope of the topic of interest, to create a ‘strategic landscape’, providing context within which specific opportunities or issues of concern can be identified (‘landmarks’).*

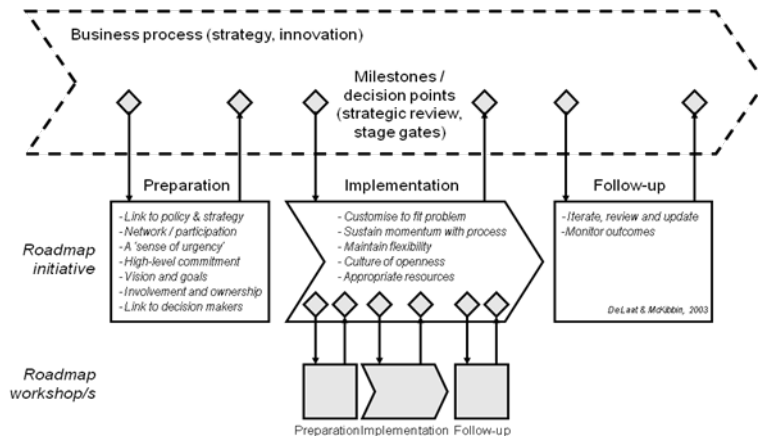
*2. Small groups then explore the specific topics in more detail, using a common template, to develop ‘first-cut’ roadmaps for review and discussion, to agree priorities, way forward and actions.*

*The key success factors for the successful development of a TRM include:*

- Context: focus, scope, aims and resources*
- Roadmap architecture*
- Process*
- Participants*
- Workshop scheduling*
- Integration: systems, processes & information*
- Preparatory work*

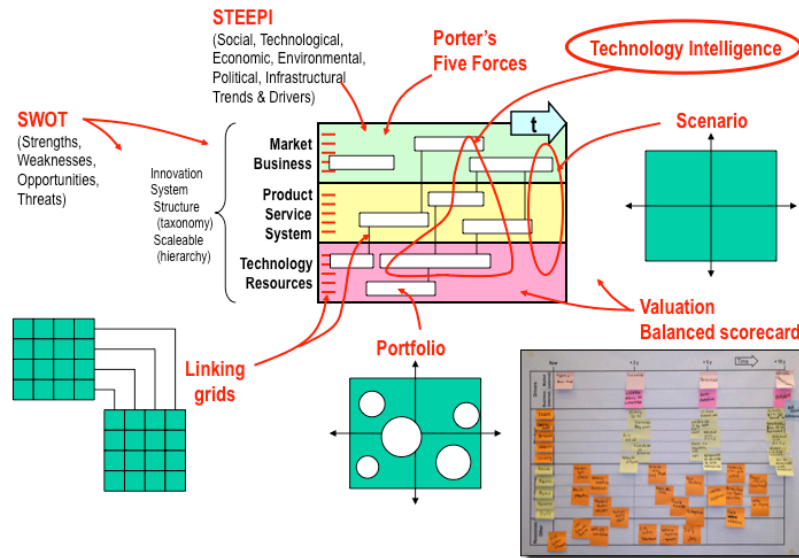
*The broader view on success factors for the TRM process and its links back to business processes would draw upon issues in the following diagram.*

## Process & success factors



(iii)

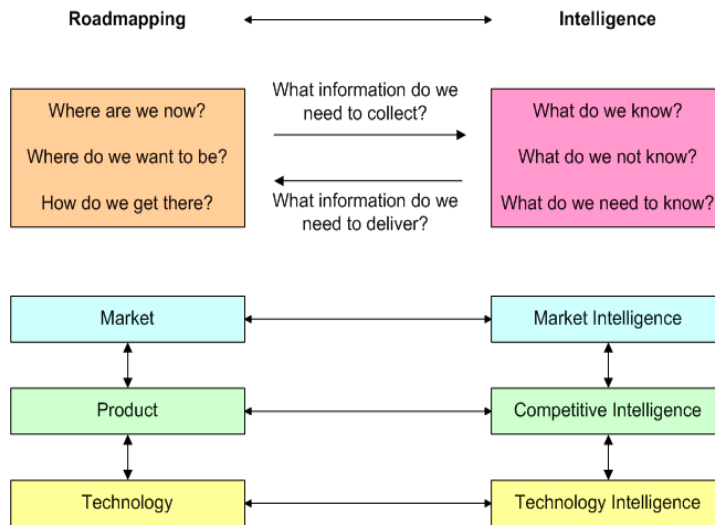
Answers should discuss a selection of the tools shown in the figure below. Good answers would demonstrate both knowledge of the tool, and where and how it fits into the TRM and its development.



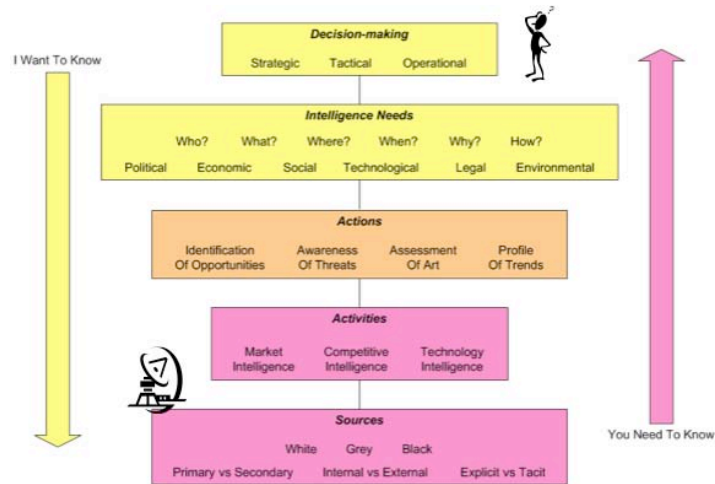
(iv)

As shown in the figure above, TI activities can provide input at all three levels of the roadmap. TI activities can support the TRM process before and after and TRM workshops, providing the background

*evidence and context to support the TRM. In terms of interactions, TI and TRM, a basic answer should discuss the following interaction:*



*Stronger answers would delve more deeply into the ‘push’ / ‘pull’ aspects of TI both feeding into the ‘actions’ (see figure below), one of which could be the development of a TRM.*



Kerr et al. (2006)

Examiners Comments. An extremely popular question answered by 93% of the class that focused on the core technology management processes. All candidates being able to describe the 5 core technology management processes. The development of the technology road map was discussed in much detail by most candidates. Whilst this was a high scoring question, marks were lost for not providing sufficient detail on the technology intelligence activities or for lack of clear and detailed diagrams. Road Mapping was well understood on the whole.



## Q5 CRIB

(a)

### **1. Market and customer issues**

– Failure to understand and satisfy market need

### **2. Technology issues**

– “How innovative do I want to be?”

### **3. Capturing the value**

– Weak appropriability (IP)

– Poor access to complementary / (co)specialised assets

### **4. Product strategy and planning**

– Incoherent product range

– Too many projects at any one time

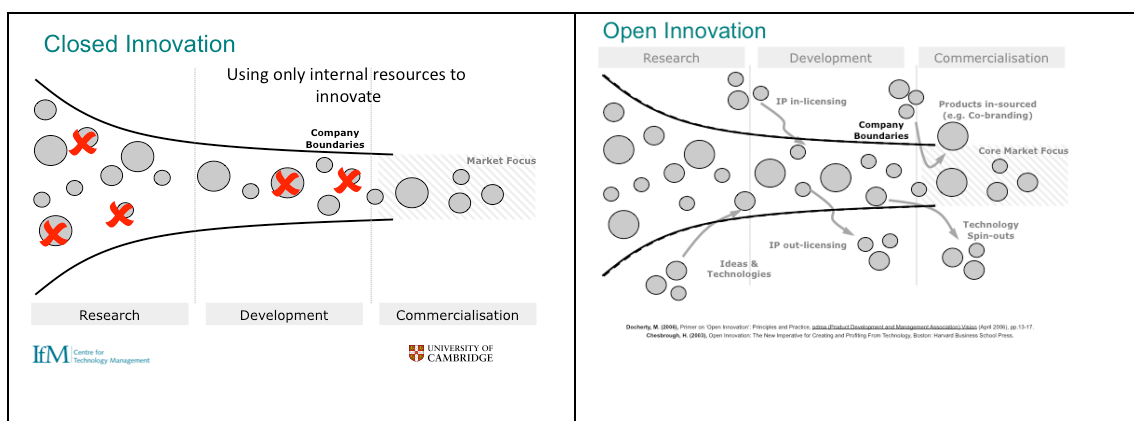
### **5. New Product Introduction (NPI) Process**

– Chaotic process, often late, over cost, many mods required

– Not geared to creativity / entrepreneurial activity at front-end

(b)

Students should be able to expand upon the issues represented by these two diagrams. At the basic level, they should be able to discuss the idea that ‘closed innovation’ is the creation and capture of new value drawing upon resources within one organisation; and that ‘open innovation’ is the combining of internal and external resources to create and capture new value. Better answers would discuss the details of the ‘inbound’ and ‘outbound’ activities of open innovation. Strong answers should also be able to present a balanced discussion of the pros and cons of both open and closed innovation, and the issue of ‘in-house’ transformation versus use of ‘ad hoc’ resources to deliver specific open innovation outcomes.



(c)

*A licensing strategy provides an exploitation route whereby the owner of the IP retains ownership of the IP but allows others to use it in return for an ‘up-front’ payment and/or a stream of royalty payments related to the level of usage of the IP. Small technology-intensive firms may be very resource constrained and unable to raise additional finance to support the implementation of production-based business models. Licensing can provide a low capital requirement route to market for a technology. However, challenges of this model include: ensuring strong IP protection, ability to demonstrate value of IP to potential customers, finding potential customers, agreeing valuations and payment terms, policing licencees, managing multiple relationships, et al. Strong answers should be able to discuss both the strengths and weaknesses of licensing in general, but also the specific challenges of implementing this strategy for a small firm based around a novel technology.*

Examiners Comments. A very popular question answered with 90% of the class choosing to answer this question that related to the management of innovation. Part a) posed few problems on the whole, with all students able to list and discuss the key challenges of innovation management. All candidates were able to deliver good accounts of the differences between open and closed innovation. Better answers were able to offer industrial examples to support their answer.

## Q6 CRIB

The answers to these questions can be found in the delivered teaching material. The use of novel examples outwith the teaching material is encouraged.

- a) Toxicity concerns have changed the lists of acceptable materials that can be used in products and production. Global warming concerns have led to policies that can increase energy costs while customers seek to purchase products with better energy performance, extraction pollution and energy for processing and transportation leads to higher material costs, with concern over scarce materials, higher waste costs have impacted on material strategies and operating practices in manufacturers, other impacts and responses can be identified, such as higher water costs. Various industrial examples can be used – Toyota, Unilever for manufacturing changes, ICT for material changes, etc.
- b) Positive opportunities are loosely clustered into internal and external strategies. Internal strategies affect industrial processes but are not seen by the customer. External strategies do involve the customer. External examples include the Toyota Prius product which claims superior environmental performance and reduced petrol cost for the customer. This can be contrasted with Toyota's own internal examples of leadership in various parts of its manufacturing (waste/energy/water/VOCs) none of which are intended to appeal to customers but do reduce the cost of manufacture. Ecover is a company that only uses naturally grown materials to produce cleaning products – a sector dominated by chemical processing companies using oil and other bases, this is an example of material substitution.
- c) The description of the business model must show a rational link between improved environmental performance and sustained economic performance (it especially must not rely on a claimed premium consumer attitude for success). The Riversimple example offers cars on a per-month, per-mile basis and includes the fuel. The company therefore makes more profit if it fits engines that use less fuel. The British Sugar business model is to invest in high technology processing equipment inside its own plants that ensure that all material arriving on site is turned into something valuable rather than thrown away, which contrasts very strongly with the 'core competence' business model. Implementation challenges will typically include the challenge of persuading others to co-operate, as many of the new business models ask for new behaviours from customers or from suppliers (especially in the case of Riversimple); or the challenge of building new competences (in tomato-growing in the case of British Sugar); or of persuading senior decision-makers or venture funders that the risk-reward ratio is sensible.

Examiners Comments. This question was answered by 68% of the class. Candidates have a good knowledge of the challenges and opportunities that sustainable manufacturing operations offer. In some cases, for part a), candidates chose to detail the issues relating to environmental change by citing evidence for it, rather than discussing pressures brought on industrial systems because of it. When discussing business strategies, better answers were rich in detail with industrial examples. Marks were often lost in part c) for not showing the links between improved environmental performance and sustained economic performance, and/or the lack of detail in industrial examples.