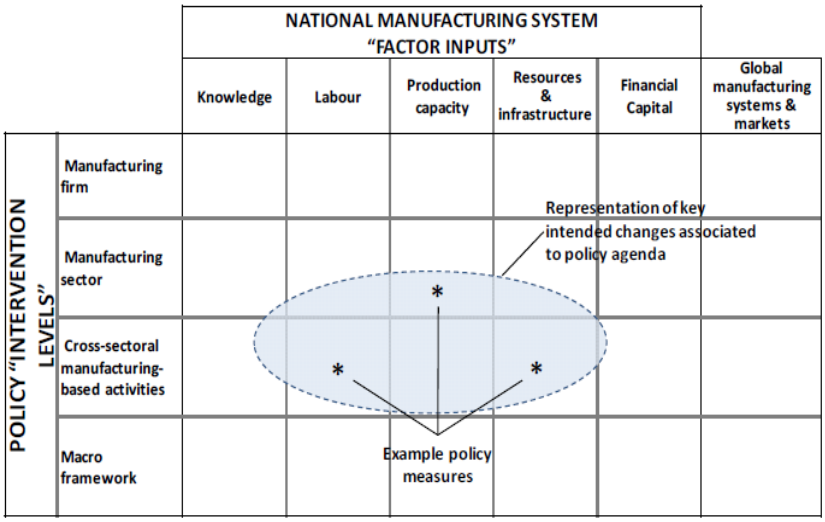
MET IIB Paper 2 2015 - Cribs

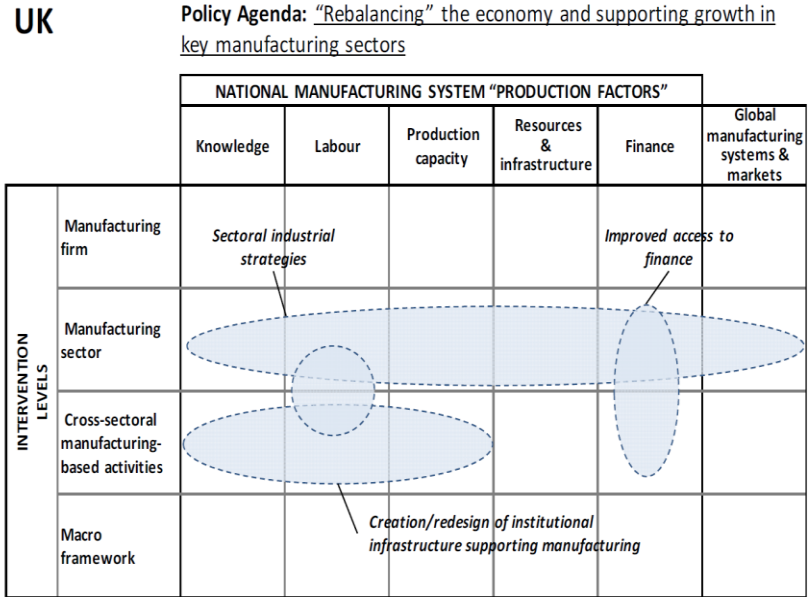
Q1

The first two sections of this question are closely related to material presented in the module. The relevant slides are attached for reference. The third part of the question requires some synthesis and interpretation by the student of material presented.

a. Good answers might present the policy matrix approach which was introduced in lectures. This allows manufacturing system factors to be mapped against policy interventions and provides a visual approach to international comparisons.

The matrix below which might be expected to be reproduced in the answer shows the manufacturing system elements or factors which are influenced by the policy and the intervention levels indicate where in the manufacturing system the policy intervention is intended to have impact.





Key factors to be included should include:

NATIONAL MANUFACTURING SYSTEM "FACTOR INPUTS"

Knowledge, Labour, Production Capacity, Resources & Infrastructure, Financial Capital, Global Manufacturing Systems & Markets.

Typical policy intervention levels might include:

POLICY "INTERVENTION LEVELS"

Manufacturing firm, Manufacturing sector, Cross-sectoral manufacturing-based activities, Macro framework.

Excellent students might be expected to discuss the shape and size of mappings on such a matrix and comment upon possible interactions between them.

b. Good answers to this section might use the UK Manufacturing Foresight approach as a model. They should highlight the processes that might be used to execute the foresight as well as some illustrations of the kind of foresight conclusions which might be expected.

The foresight process was introduced very briefly in lectures identifying the establishment of an expert group, the establishment of an industrial stakeholder group, the commissioning of "expert" background papers, international workshops and engagement with industry leading to a synthesis of findings to prepare a final report.

Excellent students might further develop this very basic outline. In addition a strong answer would be expected to highlight key trends in the context for manufacturing including:

'More than making a product and selling it'

'Faster, more responsive and closer to customers'

'Exposed to new market opportunities'

'Increasingly dependent on highly skilled workers'

'More sustainable'

and to illustrate these categories with examples from current observations.

c. Good answers to this section might vary but would have the common characteristic of setting out key dimensions of an industrial strategy and the means by which they might be implemented.
Key dimensions might include:
Scale of the sector in absolute terms and relative to international competition, the market opportunities by product type and scale, current industrial capabilities with identification of significant UK companies, challenges to future growth in terms of skills, technology and competitiveness. Potential impact of contextual factors such as energy prices, trade regulations, tax, etc.

A strategy should conclude with a clear statement of the mechanisms and actions necessary to achieve agreed targets.

Q2

A basic answer should cover:

- The **classic 'small' and 'big' organisation people management issues**. A description and comparison of the different characteristics of the two organisations (scale, structure, processes, etc) and the types of people that are likely to be working in those organisations (e.g. **in the start-up**, likely to attract people able to take on multiple activities, enjoy lots of flexibility, comfortable with minimal structure and autonomy, easy communication with others, lack of dedicated HR function to provide support; **in the MNC**, people who prefer clearly defined roles and tasks; progression pathway is clear, more focus on operations management/improvement than innovation and change, etc).
- Some reference to and reflection on the **context** within which each firm is operating. E.g. pressurised start-up environment focused on high growth, versus large complex organisation trying to overcome inertia to deal with competitive threat.

A better answer would include:

- Consideration of issues of **growth**, i.e. the start-up will be focused on how teams will deal the changes the result from growth. They may be able to get away with ad hoc approaches now, but how will team evolve over time, and how will the lessons from each project be passed on to others next time around?
- Discussion of the specific issue of **teams**, rather then general people related issues. E.g. comparison of close proximity teams in the start-up, versus geographically dispersed teams in the MNC; within the start-up there might only be one core team, but in the MNC, there will be multiple teams connected in a wide range of possible configurations; the
- Reflection on the impact that the issues in **each element** of the question implies; E.g. for the start-up: they have **received venture capital investment**, they will be expected to meet very challenging growth targets; venture capital investment is only made to those who the investor thinks can be put under pressure to deliver high performance; as this is their first VC investment, it implies that the customer base might not be that well developed; E.g. for the MNC: it is **old,** hence its workforce may have strongly entrenched ways of working that have proved successful in the past, but which may no longer be appropriate in the light of the new competition; it is a **manufacturing** organisation, hence will have substantial investment, etc.

Q3

The basic answer should cover:
(a) (i) Identification: Internal R&D; External networks (KTNs); Patent analysis, Academic conferences; Trade shows; Publications (journals, magazines, other media); Customers / end users; Competitors; Links to universities (funded labs, research, student projects, education, informal links; Trade associations and professional bodies; Consultants, Scouting, ..
(ii) Selection: Link to strategy, Business alignment, Benchmarking, Feature value analysis, Competence analysis, TRM / VRM / trajectories, Business model, Path dependency, Portfolio models, Valuation techniques (DCF, decision trees, options), ..
(iii) Acquisition: Internal R&D labs, Transfer from other business units, Purchase, Licence, Partnerships, JV, Joint / sponsored research with universities, Acquire company, Steal / copy, Reverse engineer / tear-down, Recruit, Open / distributed innovation activities, Open source / public domain material.
(iv) Exploitation: New product / service / process, Enhanced product service, Fusion with existing (internal / external), Sell Licence (Exclusive vs. non-exclusive), Open source / give away (UNIX) / donate, Partnering,..
(v) Protection: Registered IP (patents, reg. design), Unregistered IP (copyright), Secrecy, Branding, Retain key staff, NDAs, Contracts, Trickery (false patent trails), Speed of change, Get competing ideas banned, Set standard / Dominant design, Complexity..

Stronger answers might include company examples and reflection on the relative merits/costs/effectiveness of different activities within each process heading.

(b) The key issues here are that this a medium sized firm, therefore might assume limited capacity to devote time to exploring new technology opportunities. Answer should reference the five technology management processes from part (a) but focus on the ways in which these might be used in the context of ***process technology*** *such as AM/3D printing. This does not require the student to know much about AM/3DP but does require them to think about how a* ***technology at its early stage of adoption that is surrounded by lots of information 'noise'*** *(e.g. hard to understand the real costs/benefits, lots of competing technologies and suppliers, etc) and with* ***high levels of technological and market uncertainty*** *might impact on a* ***resource constrained*** *manufacturing firm (e.g. Is this going to be a key source of competitive advantage in the future? Can they risk* ***not*** *investing in it? Where might investment come from? What sort of timescales? How might the technology be deployed?).*
The basic answer should demonstrate an understanding of the typical technology management challenges facing a medium sized manufacturing firm, and how technology management tools (such TRM, scenario planning, technology intelligence, MvB analysis etc) might be used to help them deal with these challenges.
Stronger answers might reflect upon the practical challenges of implementing technology management tools and techniques (often designed and developed by large companies) in a relatively small firm. Better answers should also connect the discussion to issues such as the nature of the company's strategy and ambition, and the sector within which it is operating. Students could also explore possible different scenarios for the adoption of this technology, ranging from accessing it via a service provider, to transforming the company's core business model. This could also be considered in the context of different timeframes, and in terms of a phased approach to adoption.

Q4

a) A number of 'system level changes' were presented and discussed. These include: circular economy; industrial symbiosis; no growth; Service economy (aka product-service system); slow & local making.

One change should be named and described such that the reader can understand what change is envisaged and how that change is profound (acts on the whole system and cannot be delivered through simple technology swaps with existing technologies).
I would expect the majority of answers to offer circular economy (possibly in the guise of an extended implementation of industrial symbiosis across the economy), hence this crib will illustrate answers using his example.
The circular economy is one where no materials are allowed to escape the value system, one implication of which is that no material can degrade over time (eg down-cycle from car steel to rebar steel). This would require significant change in product designs to incorporate new materials (from old materials), changes in the supply chains, changes in the retail relationship with customers an changes to the waste system. This qualifies as acting on the whole system.

b) The crib for part a) lists a variety of changes to the industrial system. The simplest argument here is that no single actor or even group of actors can organise themselves to deliver an entirely circular economy. For example, a major retailer may be able to encourage 1st tier suppliers to design products from only reclaimed materials but the waste system must therefore be in place to provide those material – otherwise the design effort creates a solution that cannot be made. Any example which shows this dilemma of system change – that any sub-system change relies on other sub-system changes to be in place to enable its own success – will be acceptable. The logic should be clear to the marker, together with imagined examples of such a future system, to gain maximum marks.

c) System maps are any representation of the whole system. Examples offered include causal diagrams, mathematical models (of relationships between many variables), large graphics, and even metaphor.
Mathematical models are unlikely as the variables are not yet characterised, but are a correct class of system model. Causal diagrams or graphical metaphors are most likely. For causal diagrams I would expect to see at least 5 variables with relationships, plus a sensible logic for their relationships (e.g. quality of recycled material has a direct and positive relationship with the likelihood that designers will design products with that material, designers intent to use a material has a direct relationship with the availability of recycled raw materials; to successfully execute such a design designers will need education/knowledge about sustainable materials).
Graphical metaphors are used extensively to help companies think about these concepts, such as the now classic circle diagram that takes raw materials from the ground (mined or grown) and takes that material through steps until it becomes a product, the customer uses it and then the customer discards it. In the classic circular metaphor that circle is completed when end-of-life products become the starting place for new raw materials. This example emphasises material circularity, while other diagrams can emphasise that the only 'free' input we have is from the sun and that the industrial system has to learn to live with this as its capital, all else is borrowed (particularly materials) and we can use the suns energy to transform those materials into new things of value. Maximum marks should go to answers that offer both a before and after system map, that includes the typical life phases of a product, and that offer good explanation that a lay reader would understand as a potential high-functionality system.

d) three specific issues were discussed and could be offered here (others are acceptable if they show logical construction)

Firstly the drawing of any system boundary has very strong impacts on the solution that emerges. For example, if we include the actors in the waste system then novel solutions for maintaining high value in those materials becomes possible and a new system that maximises waste value could emerge (the alternative is to expect the waste system to continue on its current pathway which implies that all materials will be down-cycled and hence circularity potential is lost.

A further impact of system boundary selection is that a boundary that is drawn too tightly may be easier to map, but may dismiss key actors or actions and hence make the problem more difficult to solve. A consequence of this is that system map boundaries may change (usually grow) during the search for solutions.

Secondly, that in any complex system a key challenge is to identify the better places to act, or 'places to intervene' or 'critical actors'. Typical searches are not structured to any prevailing wisdom, but include a search for places to act that create multiple benefits (such as reducing water use in apparel manufacture also reduces the cost of apparel drying and of cooling load on the factory environment) and places to act that create positive feedback (such as making a car lighter reduces the power required and reduces the size of the engine which makes the car lighter which reduces the size and weight of the brakes, etc).

Thirdly any system map must enable the user to test for unintended consequence of planned interventions. Again there are no commonly used structured methods to achieve this, but a shared use of the map with various individuals imagining negative reactions is a common technique.

For maximum marks the candidate should name all three consequences and describe them fully. Similar concepts can be marked fully – unintended consequences for example, lends itself to many interpretations but always contain the ideas of intention and error.

Q5

(a) The Bass diffusion model consists of a simple differential equation that describes the process of how new products are adopted. Better students might provide the basic Bass diffusion formula, in order to more clearly explain the model, as follows.

$$N_t = N_{t-1} + p(m - N_{t-1}) + q\frac{N_{t-1}}{m}(m - N_{t-1})$$

In this formula, N_t indicates the number of companies (or people) using the innovation at time t.

The three parameters of the model are:

- m = the market potential; the total number of people who will eventually use the product
- p = the coefficient of external influence; the likelihood that somebody who is not yet using the product will start using it because of mass media coverage or other external factors (innovation effect)
- q = the coefficient of internal influence; the likelihood that somebody who is not yet using the product will start using it because of "word-of-mouth" or other influence from those already using the product (imitation effect).

The model outlines how current adopters interact with potential adopters of a new product in order to influence the total adoption. Adopters can be classified as innovators who tend to be influenced by direct information such as advertisements, or as imitators who are influenced by word of mouth recommendation from others who have already adopted. The speed and timing of adoption depends on their degree of innovativeness, and the degree of imitation among adopters, which typically gives an S-shaped adoption curve. The Bass model has been widely used for new products' sales forecasting and technology forecasting.

(b) Scentiful believes that the customers of high-end department stores who purchase perfumes will tend to tell their other friends, relatives and colleagues about the benefits of Rosentine – this will create the word of mouth effect to encourage imitators to buy Rosentine. These friends, relative and colleagues are likely to be people with similar tastes and purchasing power to innovators, and who will then go and buy Rosentine.

Possible reasons to launch the perfume in luxury boutiques and high-end department stores and to capture the innovators first through direct information are:

(i) to build the brand as an upscale perfume

(ii) to be able to charge premium price for the product

(iii) to skim the top end market before moving to the lower end of the market

(iv) to be able to provide more targeted advertising

(v) not to dilute the brand identity of its perfume range

(c) The Bass model does not typically consider:

(i) the customer utility and purchasing decision but provides a descriptive model of the diffusion process

(ii) the uncertainty in customer preferences

(iii) impact of competitive products on the sales are not explicitly accounted for

(iv) the diffusion curve does not take into account more than one segment in the population (e.g., early adopters might be a different segment to late adopters). This could result in two S-curves overlapping with each other.

(v) the diffusion curve does not take into account technology developments that might need to be incorporated into products which might display 'chasms' in the s-curve.

Better students might also discuss some further limitations such as:

(i) other factors that might crowd out advertising messages of the product

(ii) there might be many overseas purchasers during Easter time which might limit word of mouth recommendations

(iii) competitors might launch similar products which might affect the interaction of the innovators and imitators effects.

Q6

(a) <u>The basic answer should cover:</u> Key issues: technology-intensive industries are characterised by high levels of technological and market uncertainty, which results in high levels of perceived risk. One way of managing this is through sharing the risk with others, and also accessing a wider network of resources and capabilities to help reduce the uncertainty. To do this requires the development of certain collaborative capabilities that build upon the core of MvB / outsourcing. This should be expanded upon through illustration of forms of collaboration in different companies, technologies and sectors.

<u>A better answer might</u> include consideration of:

- *The impact of the emergence of 'open innovation' and the way in which many firms have developed collaborative capabilities for innovation;*
- *The way in which different underpinning technologies may lend themselves to a more collaborative approaches within specific sectors (e.g. the 'open architecture' model of the PC enabled a wide range of collaborative / outsourcing opportunities), as well as the impact that the Internet and WWW has had on a broad range of sectors to enable more collaboration (for SCM, collaborative design, etc)*
- *The extra dimensions that need to be added to make versus buy decisions when considering early stage technologies.*

(b)

<u>The basic answer should cover:</u>

Partnerships rest upon individuals from different environments working together. Successful partnerships are based around mutual trust (= (Credibility x Reliability x Intimacy)/Self Interest). Trust is very difficult to build and easy to lose. Trust is built within a context defined by different cultures (organisational, national, sectoral), different operational 'clockspeeds', different motivations, multiple internal and external stakeholders, etc. There should be discussion of issues of relative importance of the partnership to each partner, the role of contracts versus relationships, etc.

<u>Stronger answers might</u> include reflection on how the issues of:

- *How 'technology intensive' –related issues could impact possible partnerships. This might include comparison of high levels of protection of ideas (e.g. IP battles between Apple and Samsung) with the need to get teams from these organisations working together to address the issues discussed in (a).*