1

(a)   A major European supermarket has recently been facing rising supply chain costs. Analysis of supply chain data revealed that orders to suppliers (e.g., wholesaler to distributor, and distributor to manufacturer) tend to have a larger variability than sales to buyers, resulting in an amplified demand variability upstream.

(i)   Explain three possible causes of such dynamics in supply chains.

[15%]

(ii)   Discuss possible strategies that the company can use to reduce the impact of such supply chain dynamics on operations.

[25%]

(a) Answer:
(i)   Demand variability results in small changes in consumer demand resulting in large variations in orders placed upstream. Supply networks can have very large swings as each organisation in the supply chain seeks to solve the problem from its own perspective. This phenomenon is called the Bullwhip Effect. The key causes of such dynamics are:
   a. **Forecast Variations**
      - *Demand forecast inaccuracies along chain (e.g., different supply chain partners using different forecasting models, assumptions, and safety stock requirements)*
      - *No visibility of actual consumer demand (only the retailer sees the actual consumer demand – the others just see their immediate customer demand, which are the orders placed by them based on forecasts and safety stock requirements)*
      - *Promotions – result in forward buying to benefit from lower prices (*
   b. **Poor Communications between supply chain partners**
      - Lack of communication and coordination up and down the supply chain *(e.g., due to competitive pressures/concerns, to eliminate leverage).*
      - Long lead times (for material and information flow)
   c. **Inappropriate Decisions**
      - *Decisions made locally (by one business) not globally (by the whole supply chain)*
      - *Conservative decision-making (to avoid stock outs)*
      - *Managers are generally risk-averse*
      - *Risks are usually not symmetric – stockout hurts more than excess*

- *Inflated orders due to fear of shortage*
  d. **Limited Response Capabilities**
    - *Order batching – larger orders result in more variance*
    - *Capacity Limits*

[Note: Basic answers will cover three of the four issues. Good answers will elaborate (based on the bullet points) and excellent answers will discuss them using examples covered in the module and in the context of supermarkets (e.g. drawing from ideas discussed in lectures from Tesco and Ocado).]

(ii) The key strategies that are used to address these issues can be grouped under the following:

a. Structure

- Co Location – supplier on site. Associated strategies are Vendor Managed Inventory and Just in Time supply
- Compression – reduce one or more steps in the supply chain, Factory collection and Direct to Customer from warehouse.
- Multiple Routings – Multiple sources/suppliers [local, global], Access to Multiple Distribution Centres
- Pivot Point / Push-Pull Supply chains – make to stock until a certain point in the supply chain and make to order for the rest. In some cases, the pivot point might even be inside the factory.

b. Inventory

- Choice of where to hold the inventory – as per push/pull models. Consideration should be given to cost as well response issues.
- Differentiating different types of Inventory and how much to hold of raw materials, work in progress and finished goods. Balance must be struck between stock out risks and overstocking at each stage.
- Improved approaches/tools for modelling demand/supply uncertainty and algorithms to optimise inventory.

c. Resources (Consider different types of resources)

- Transport – shared transport/cross-docking/mixed case pallets (e.g., Tesco)
- Processing/storage - Warehouses organised around orders vs product types, Production paths with shorter lead times
- Receipt / Dispatch - Systems to reduce delays at arrival / departure: e.g. RFID, eProcurement etc.

c. Information

- Uncertainty Reduction: demand and supply - Demand: forecasting – levels and variability; Supply: tracking of deliveries, supplier visibility.

- Reduced delays and errors - Automated Data Capture; Linked Data Capture / Data Management; Reduced Inferencing
- Greater, simpler information sharing - Systems to enable simple & secure data access; Data sharing agreements

[Note: Basic answers will cover the four issues. Good answers will elaborate (based on the bullet points) and will discuss them using industrial approaches such as from Tesco and Ocado. Excellent candidates will try and draw out ideas for data-centric decision making based on digitalisation and machine learning.]

(b) An engineering firm manufactures security equipment for airports. Some of their critical components and raw materials are procured from suppliers based in Russia and Ukraine. The firm is currently facing supply chain disruptions and incurring losses. In this context:

(i)   Explain the terms *event, vulnerability, risk,* and *resilience*.

[20%]

(ii)   Explain how you would develop an end-to-end supply chain risk management approach for the firm.

[40%]

(i)

- Events within the context of supply chain refer to global events such as war, extreme weather, natural disasters etc. It considers risks that are global in their nature and impact. Some of such events may not affect all supply chains as some supply chains has inherent resilience capability built-in their design. In the context of the question, the event is *Russia's invasion of Ukraine*.

- Vulnerability within the general context of supply chain refers to weakness in supply chain design as such single sourcing, low inventory policy etc. These vulnerabilities may not exist in all supply chains as each supply chain is uniquely designed based on product, process and locations characteristics. In this context, the vulnerability for the engineering firm is t*he location of key suppliers for their products being based in a war-torn region*. The scale of this vulnerability will depend on the existence of alternate suppliers elsewhere.

- Risk in the context of supply chain is defined as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety. In this context, the risks are *increased cost of switching suppliers, the probability that alternate suppliers*

can deliver materials of suitable quality and meet necessary security regulations, and the possible impact of equipment failure at airports (both in terms of the reputation of the company as well as any security impact on the respective countries where the airports are based).

- Resilience within the context of supply chain: A resilient supply chain is defined by supply chain design characteristics for resistance and recovery. That means having the capability to mitigate most supply chain disruptions and greatly limit the impact of those that occur. Having a well thought-out risk management approach is essential for building resilience.

[Note: Basic answers will present an understanding of these four terms within the context. Good answers will build on the basic and elaborate the terms and will discuss them within the context of the company.]

(ii)   Students are expected to use either a traditional approach or configuration approach for end-to-end risk management. Configuration approach involves "end to end supply chain visibility" and the Traditional approach can only include tier-1 suppliers in the analysis.

A risk management approach consists of broadly four phases:

(1) Risk Identification
(2) Risk Assessment
(3) Risk Mitigation, and
(4) Risk monitoring

The traditional approach is linear and does not explicitly allow mapping of the supply chain/network and the wider risks. The key steps involved in the traditional approach is shown in the figure below:
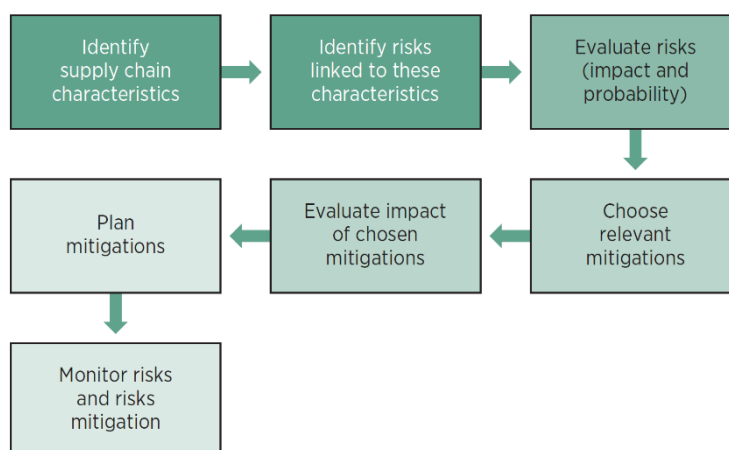
Identify supply characteristics and identifying risks linked to these characteristics: This involves the examination of

a) **management and policy level issues such as**:

- whether the company is using a "make to stock" process based on forecasting
- The company is facing lack of experience or poor communication with suppliers/distributors*
- Plants are working close to full capacity
- The company is facing bad communication/relationship with the workforce
- The company is facing bad communication between R&D and production functions

**b) Product, Process, Technology level Characteristics**
- Products involve specific technical / safety / health requirements*
- Critical raw materials (either rare or single sourcing) are required in the process*
- Unreliable machinery/equipment or new machines with complicated set-ups are used in the process
- Processes require high amount of energy or raw materials with highly volatile prices or workforce working overtime*
- Quality is a key aspect in the process*
- Process involving toxic products potentially harmful for the environment
- A new process line or inexperienced workers are involved in the process
- A key operator is required for the process

c) Geographical location level
- Some Plants are located in developing countries
- Some plants are located in areas facing high probability of natural disaster
- Some plants are located in area facing high probability of terrorist attacks
- Some plants are located in countries facing unstable political situation*
- Some production costs (wage, energy…) are to be paid in a foreign currency*

[Note: good answers provide a list of some of these issues, but excellent answers will identify specific characteristics (*) and associated risks related to the company in question linking it to the industrial lectures in the module]

Risk assessment involves the selection of high and medium risks and quantifying the probability and potential impact of those risks, leading to a risk score. Risk mitigation involves the following steps:
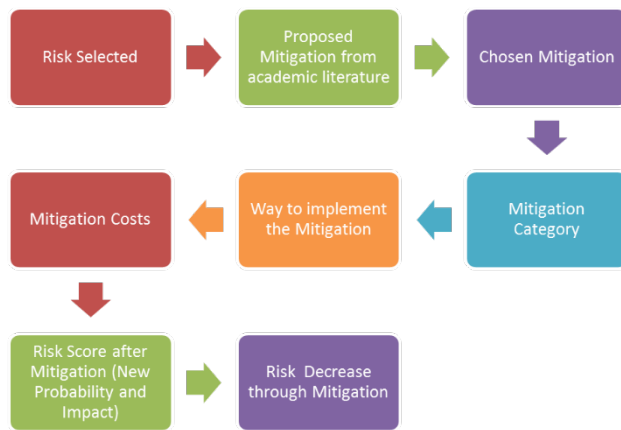
Possible mitigation strategies for the current risk that the company faces involve the identification of potential suppliers elsewhere in the world, clearly assessing these suppliers for quality, compliance with security regulations and cost. The potential new risks arising from choosing alternative suppliers should be clearly understood and evaluated. A further alternative is to explore the possibility of bringing the manufacturing of these critical components inhouse. Generic supply chain risk management strategies and associated emerging risks are shown in the figures below:


A good risk management plan will include regular risk monitoring as illustrated in the diagram below:
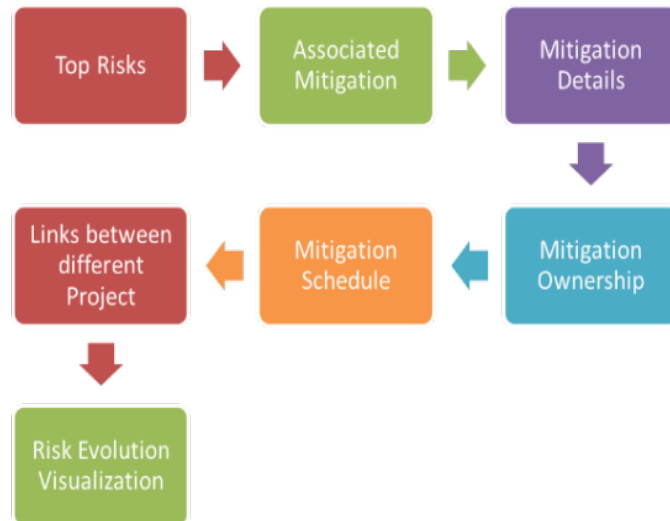
Students might also discuss the configuration approach in this context. This involves mapping the supply chain, understanding the characteristics of the event, identifying the risks arising from the event by overlaying event data on the supply chain map, and identifying mitigation strategies, which involve changes to the network structure, alternative process flows, adjusting the value structure and product redesign.
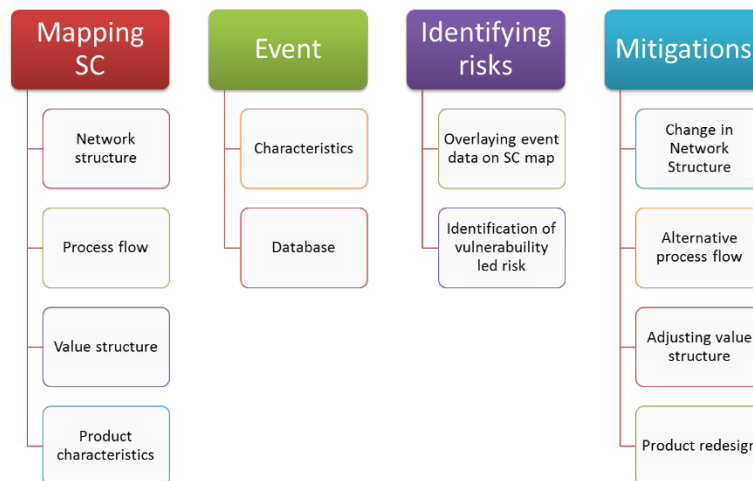
[Note: The basic answers will provide a general description of the selected approach. A good answer will describe each step in detail with a rationale for the selection of the approach. The excellent answers will build off the good answer and provide specific examples linking industrial lectures in the module. The context specific supply characteristics are marked with an (*) in the cribs above.]

QUESTION 2

(a)

(i)
Basic answers will refer to the fourteen circular economy (CE) service business models that could be used by manufacturers. Basic answers would explain the four subdivisions of CE service business models –1) product-oriented, 2) user-oriented, 3) results-oriented and 4) end of life– and define at least the seven CE business models.

1. ***Product-oriented services business models.*** These business models encourage the extension of life assets. Generally, in these business models the asset is own by the customer and the responsibility for the maintenance and disposal of the asset is with the assets' owner.
   1.1. Maintenance: the PS provider offers maintenance services that may be performed on- or off-site, directly or remotely, programmed or available 24/7 for emergencies.
   1.2. Repair: activities are likely to be covered by a standard warranty, in accordance with the current laws and regulations. The repair service business model enables the extension of life of current [own] assets and therefore delay the disposal of unfit/broken assets and therefore delay the need to buy new assets. The reuse of assets slows down the consumption of new materials too. This model creates alternative revenues to companies/OEMs.
   1.3. Remanufacturing/Refurbished: The PS provider sells remanufactured/refurbished products or refurbishment services for the existing products. This business model extends the use of the product by enabling a different user the ownership of the product. Environmentally, it reduces the needs of new products and minimise the consumption of raw and scarce materials. Economically, it opens new markets.
2. ***User-oriented services business models.***
   ▪ **These business models encourage the Reuse of entire assets:** user–oriented services maximise use of assets, driving down spare capacity of assets. These business models secure a regulatory compliance of assets at their end of their lives. Because of the maintenance of these assets are shared between different users, the user pays for availability of the asset without over investing in maintenance of individual assets.
   2.1. Leasing: The lessee pays a regular fee for unlimited and individual use of the product.
   2.2. Short-term / Long-term renting: The customer uses the product individually for a predetermined (short/long) period.
   2.3. Sharing: the product is sequentially used by different customers.
   2.4. Pooling: The pooling approach requires the simultaneous use of a product by different customers.
3. ***Result-oriented services business models.*** The impact that these service business models have on the environment and the full circular economy is massive. In these service business model, the assets are generally own by the service provider. Hence it is intrinsically beneficial for the service provider to extend the life of the assets and provide

ethical disposal of them because it is their contractual responsibility. Service contracts are generally long and significantly profitable but these are offered to very few customers.

3.1. Pay per use: These service business models enable customers to use assets and they pay for the actual use of them rather by the ownership of the assets.

The environmental impact of these business models is massive because stronger more reliable parts are use in these types of service contracts, therefore there is a reduction on scrap levels coming from repairs and spares. The use of smart technologies allows higher levels of predictive and prognostic maintenance while maximising the customer experience in using these business models' assets. More sophisticated analytics – prognostics and predictive –enable new simplified and efficient methods of operations to enable better value for money to customers. The use of more diverse set of knowledge in this type of service business model encourage a more diverse set of expertise to join the work force in these types of companies.

3.2. Outsourcing: The service provider manages one or more activities for the customer, but the decision regarding how to perform and control these activities remains the customer's responsibility.

3.3. Pay by result: This sustainable service business model makes the customers objective the service provides objectives. The contracts are longer than other service business models. The asset provenance is irrelevant, what is more important is the asset's adequate design to fulfil the overall customer objective rather than to prove it own individual efficiency. Typical assets are just part of large synchronised system by the coordination of a digital fabric with the aim to hit the promised customer contract target.

4. End of life services business models.

4.1. Recycling: The service provider removes the product and provides recycling/dismantling services. This service is common in the electronic and home appliance industry. Economically, it is still a grey area as many manufacturers and OEMs have not yet workout the ethical circularity of the product. For third party recycling providers, this is a model that could be profitable if appropriate infrastructure and data are set.

4.2. Repurposing: The service provider uses the end-of-life asset and generates a new different product/service out of it for a particular purpose. For instance, in repurposing of old diggers, the engines are used for other transport uses.

4.3. Disposal: The PS provider creates a service for ethical disposal of assets.

Strong answers will discuss the difference between four subdivisions of CE service business models –1) product-oriented, 2) user-oriented, 3) results-oriented and 4) end of life. Comparison will be around the ownership of assets versus the access to the assets on an environmental context. Other stronger answers might include the service providers core competencies and capabilities.

Best answers will compare and contrast the environmental output of some of these business models and the level of risk taken by the service provider. An economical and environmental comparison of the return on investment between some of these service business models would be expected.

(ii)
Basic answers will illustrate with examples some of the fourteen circular economy (CE) service business models offered by manufacturers. Illustrations will be expected to describe some cases examples discussed in class and from the student's own experience.

1. *Product-oriented services business models*
   1.1. Maintenance: For example, Philips Healthcare provides a global remote diagnostic service, allowing the identification of system errors for diagnosing and immediate remote repair. Mercedes Benz provides an express service for car maintenance that elongates the safe use of the asset within the right environmental regulations.
   1.2. Repair: Examples are maintenance services from Volvo digging machines, John Deer combined harvesters by repairing the existing machines they extend the life of these assets and therefore delay the disposal of broken assets and subsequently delay the need to acquire new assets. To the environment, the reuse of assets slows down the unnecessary consumption of new materials. Therefore economically, the repairs enable reuse of assets, create lateral economic revenues to service providers and subsequently generate of extra new jobs.
   1.3. Remanufacturing/Refurbished: The CAT Certified Rebuild Program offers a like-new machine with a like-new warranty and a new serial number starting from an old product that has been completely disassembled and rebuilt from the ground up to include all CAT product updates. Apple provides special offers for refurbished Macs & iPods; This business model extends the use of the product by enabling a different user the ownership of the product. Environmentally, it reduces the needs of new products and minimise the consumption of raw and scarce materials. Economically, it opens new markets even in developing countries. Other examples include Annabella Pelliccerie, Siemens MRI.

2. *User-oriented services business models. These examples of* services maximise use of assets, driving down spare capacity of assets. Environmentally these business models secure a regulatory compliance of assets at their end of their lives. Economically, because of the maintenance of these assets are shared between different users, the user pays for availability of the asset without over investing in individual maintenance.
   2.1. Leasing: Norbain SD, which is an English distributor for Access Control and Intruder Detection equipment. Other leasing examples include Mercedes, BMW, Nissan-Renault.
   2.2. Short-term / Long-term renting: For instance, with Peugeot Renting. It maximises the use of cars and minimises spare capacities of assets own my individual customers.
   2.3. Sharing: Zipcar is a membership-based car sharing company providing automobile rentals to its members that are billed by the hour or day. Other examples include: eMilan.
   2.4. Pooling: Examples include Turbine Apache and the American company Rideshare.

3. *Result-oriented services business models.* These business models have a massive positive impact on the environment.
   3.1. Pay per use: Ricoh provides PS solutions and offers a cost-per- page formula. The service provider covers the activities needed to maintain the availability of the

copying function in the customer office; the customer pays based on the number of printed copies. Other close example includes the "Total Care package" service from Rolls-Royce Aerospace Plc retains the ownership of the gas turbine engine instead of transferring it to the airline companies to deliver "power-by-the-hour". The environmental impact the power-by-the-hour has is enormous, because stronger more reliable parts are use in these types of contracts there is a reduction on scrap levels coming from repairs and spares. The smart technologies used in the power by the hour allows higher levels of predictive and prognostic, therefore the maintenance is better scheduled to meet regulatory compliances while maximising the use and experience of the asset. Because the advance prognostics and diagnostics systems of assets, more accurate and even new forms of monetization are created – for instance, from the power-by-the-hour model, new simplified methods of operation involving more reliable suppliers and even more cost effective have been created. Some might say that it enables better value for money.

3.2. Outsourcing: ABB– with the Full-Service Maintenance Performance Management, ABB takes the responsibility for the engineering, planning, execution, and management of an entire plant's maintenance activities under a long-term, shared- risk, shared-reward contract.

3.3. Pay by result: Orica provides a functionality-based pay-per-result solution; with the "Rock On the Ground" (ROG) solution, it can provide its customers with complete services tailored in-situ, including design, process simulation and mining support for blasting process optimisation; this optimisation includes planning the blast, drilling the holes, inserting the explosive and firing the blast. Thales Training & Simulation is a solution for training pilots and managing simulator building facilities.

4. End of life services business models

4.1. Recycling: E.g., Braun, Electrolux, Motorola, Nokia, Sony. Environmentally, many superconductors and chemical materials are recovered and reused in the same supply chain or use for repurposing models. Ethical recycling brings huge benefits to the environment and ecological sustainability of the land, air and water. Economically, many service providers and OEMs have not yet arrived to the ethical circularity of products, material and parts. For third party recycling providers, this is a model that could be profitable if appropriate infrastructure and information are provided.

4.2. Repurposing: In repurposing old marine ships, the panels are repurposed in construction. Repurposing extends to the very end the use of assets, as the CE principles say it contributes to the environment by eliminating the need of a new asset and raw material consumption. Economically, this creates an extension of revenue.

4.3. Disposal: For instance, the Man Trucks disposal services.

Strong answers Strong answers will compare and contrast example cases from the fundamental Circular Economy services business models with the more advance ones. For instance, discuss examples from the maintenance or repair business models and compare them with more advanced case examples from pay-per-use or user-oriented service models. Illustration of the case examples will be principally made from the environmental perspective.

Best answers will focus on the case examples of Reuse service business models arguing the superiority on their CE principles – environmental, economic and social impact – for various stakeholder in short and long term. Illustration of cases will be discussed from the

environmental, economic and social/industry aspects. Some of the best answers might be able to distil few environmental and economical patterns of a couple of service business models, such as in the line of digitalisation and orchestration of operations across distributed suppliers/ networks.

(b)

(i)
Basic answers will describe sustainable value as the integration of economic, environmental and social value into the business model, and identify generic forms of sustainable value such as:

- Sustainable economic value **-** profit, growth, return on investment, financial resilience, long- term viability and stability. The company business model is focused on the long-term contractual relation based on the continuous evolving customer needs and customisation of the storage. Examples could include the storage solutions for a traditional young family and its evolution. The evolution would reflect the lifecycle of the family and its storage transformation over time – size, purpose and layouts.
- Sustainable environmental value - use of renewable resources, low emissions and low waste levels within the ability of the environment to metabolise safely, pollution prevention (air, water, land), lower use of energy in the production of the storage solutions, protection of bio-diversity, positive benefits to the environment.
- Sustainable social value **-** secure and meaningful livelihoods, fair labour standards and practices, well-being, health, community development, poverty alleviation, social justice, equality and diversity.

Strong answers will interpret and relate these forms and identify company-specific forms of sustainable value. This might include prioritising long-term viability and stability over short-term growth; a new eco-building to reduce energy use and emissions; reuse all packaging; trust between company and customers; secure livelihoods of employees.

Best answers will also apply the concepts of value captured and value uncaptured (missed/destroyed/surplus/absence) to categorise different forms of sustainable value for the various stakeholders of the company. Best answers will compare the value creation with other case studies presented during class such as, AB Sugar, Elvis & Kresse, Formula E, Riversimple, Vestas and future trends covered in the module as well as general knowledge and understanding of the furniture industry.

(ii)
Basic answers will describe some of the elemental Factors that have support Vitsoe's unique business models including the product design factors, long lasting customer/users need factors, tight supply chain, trusted supply chain, natural materials' access, reconfigurability not only of the product but also of the company over its lifecycle.

Stronger answers will provide some leadership and strategic factors in the uniqueness of their business model and their roots to the Nordic influence of doing business. Some other factors will include the closeness proximity to customers designed and plan by the business model of the company. The answers would be expected also to describe the importance of the role of the customer as a sustainable co-creator as a factor.

Best answers will provide a comparison of key factors between Vitsoe with other advance business models such as pay-per-use ones such as the 'power-by-the-hour from Rolls Royce, CAT mining services or Orica.

END OF PAPER

Question 3

(a) Explain why managing change in a large, long-established organisation is so difficult, and what can be done to increase the likelihood of success.

[25%]

(b) You and your best friend are CEO and CTOrespectively, of a start-up company that applies machine learning to predict supply chain risks for manufacturing firms. You have received your initial investment of £500k from a Venture Capital (VC) fund for an initial deployment of the technology. You are talking to the VC fund about raising an additional £5 million to grow the business substantially and rapidly in response to high market demand. However, the CTO is more comfortable keeping the business relatively small and wants you to take a more cautious approach to developing the business.

Discuss the people management issues that you, as CEO, would be most concerned about within the context of the potential rapid expansion of the business.

[40%]

(c) *"Partnerships are enshrined in contracts, but require people to negotiate, agree and deliver them. People are idiosyncratic, so relationships take time to build and depend upon trust"*
Discuss, using examples, the challenges of forming and managing partnerships in conditions of rapid change within the context of above statement.

[35%].

Outline crib:

(a)

Basic answer
Students should be able to at least <u>describe</u> the three basic types of change, and the common triggers for and barriers to change, as shown in the lecture slides below.

Students should be able to <u>articulate</u> the links between the characteristics of a large organisation (as shown in the table below) and the challenges in managing change. The basic answers should, as a minimum, highlight issues of organisational complexity and inertia as a common cause of resistance to change. In addition to these 'core' issues, there are a range of contextual factors that a basic answer should acknowledge, I.e. characteristics of sector (clockspeed, competition, maturity etc) and firm (age, scale, multinationality, culture, ownership, etc). The basic answers should be able to demonstrate an awareness of how these factors affect the selection of an appropriate approach to change management.

As the firm grows, (almost) everything changes

	Start-up company	Established company
Processes	Informal; ad hoc; rapid	Formal processes; slow paced (e.g., design review; document control
Systems	Few	Many systems, tried and tested (e.g., technical database, financial systems)
Activities	Heroic individual efforts; chaotic; initiative based	Cross-functional teams; managed tasks; delegated authority; coherence
People	Many creator / innovator types; role flexibility	Managed balance between types; clear job descriptions
Management style	Hands-on, informal; bold decisions taken on incomplete information	Delegated, professional style; risk assessment; staff development
Communication and documentation	High dependence on verbal communication and memory; 'everyone knows everything'	Greater use of written communication; controlled dissemination; 'need to know'
Market information	From intuition, insights and belief; reliance on feedback from small sample of (potential) customers	From experience and market research; statistical sampling of customer needs and price sensitivity
Competitors and IPR	Limited competitor awareness; limited IPR protection	Very aware of competitors; careful and strategic use of IPR.

Source: Willie Harrison, TAF

Basic answers should be able to <u>describe</u> at least one model of change management, be it Kotter, or Lewin, or Dannemiller and Jacobs, providing detail on each of element of each model, illustrating their responses with examples covered in the module, or drawn from elsewhere. The basic answer should be able to <u>reflect</u> on the operational challenges of implementing any of these models.

Stronger answer
The stronger answers would build on the basic response but, for example, improving by linking change management to issues of <u>organisational ambidexterity</u>, I.e. change doesn't happen in a vacuum and there are on-going 'business as usual' issues to be managed in parallel with change management. The module content - including the module assessment - provides plenty of examples on which students can draw to illustrate this point. Stronger answers would also introduce issues of the links between <u>leadership style</u> and the selection / implementation of an appropriate change management approach. The case studies used

in the module provide examples that could be used to illustrate and reflect upon this point in some detail.

Excellent answer

An excellent answer would demonstrate that the student has appreciated the highly contingent nature of change management, even within the apparently bounded context given in the question. The strongest answers would explore examples that illustrate aspects of these contingencies, either through use of cases from the module (e.g. the NHS) or their own readings. Such contingencies could include issues relating to the changing nature of the technology domain within which the firm operates, or the ownership structure in the context of specific economic conditions (e.g. the impact of private / public ownership during an economic boom or downturn), or the role of the political / industrial policy context, as illustrated in the EGP module – and reinforced in the Leadership and Managing People module.

(b)

Basic answer

There are a range of generic and context-specific issues that need to be covered in a basic answer. Firstly, students, should be able to demonstrate awareness of the generic characteristics of a fast growing, tech-based business, as was introduced in MET IIA but repeated and reinforced at the start of the Leadership and Management People MET IIB module. To frame these issues, the simplest approach would be to link the features of this case to the stages of 'Opportunity Cycle of Enterprise' (as shown in slide below left) and the organisational blueprints discussed in the results of the Stanford Project on Emerging Companies (SPEC) (below right).
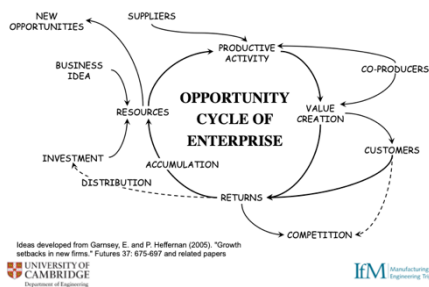
SPEC employment blueprints

Employment Blueprint	Dimensions		
	Attachment	Selection	Coordination/Control
Star	Work	Potential	Professional
Engineering	Work	Skills	Peer/Culture
Commitment	Love	Fit	Peer/Culture
Bureaucracy	Work	Skills	Formal
Autocracy	Money	Skills	Direct

Secondly, students need to demonstrate awareness of the context specific features of this case, and the impact these characteristics these will have on the people management issues the CEO needs to consider. Key features to be highlighted in a basic answer include: this firm is young, first growing, founded and run by two people who have a close personal relationship, deploying a technology that is experiencing rapid adoption in multiple application areas and which requires very specific skillsets, operating in a market that is diverse and which requires a high level of operational awareness to ensure that the business offering aligns with local needs.

Stronger answer

Stronger answers could draw upon issues from the start-up case study introduced and discussed during the L&MP module. This case study provided excellent material and a structure for reflecting upon the challenges presented by (a) being in a business venture with friends while (b) managing external stakeholder (e.g. VC) expectations. Stronger answers would also raise questions about issues not covered in the introductory paragraph, e.g. business ownership (does the CTO have a significant share of the business?), IP (is the CTO the owner of the company's core IP?)
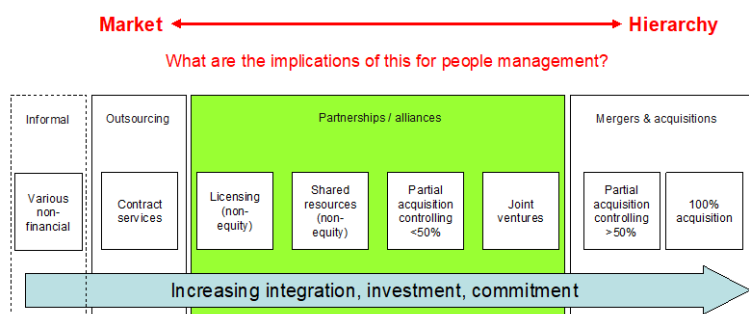
Excellent answer

The best answers would be able to be able to structure the basic and stronger issues above within a higher level issues such as the links between the articulation and evolution of company vision, strategy and business model in the context of leadership and managing people.

(c)

Basic answer

The basic answer needs to demonstrate understanding of what is meant by the three terms: partnership (it's a range of governance modes – see below); contracts (*"An agreement which gives rise to obligations that the law will enforce"*); and trust (*"Trust enables deals to be done and enables problems to be overcome"*). Collaborative agreements available are illustrated in the slide presented below.

Types of collaborative agreements

Market ← → Hierarchy

What are the implications of this for people management?

Informal	Outsourcing	Partnerships / alliances				Mergers & acquisitions	
Various non-financial	Contract services	Licensing (non-equity)	Shared resources (non-equity)	Partial acquisition controlling <50%	Joint ventures	Partial acquisition controlling >50%	100% acquisition

Increasing integration, investment, commitment

Adapted from Marqulis, M.S., P. Pekar Jr., (2003), The next wave of alliance formation. Forging successful partnerships with emerging and middle market companies. Los Angeles, Houlihan Lokey Howard and Zukin.

UNIVERSITY OF CAMBRIDGE
Department of Engineering

IfM Manufacturing Engineering Tripos

The basic answer should then be able to demonstrate understanding of the process of partnering (as shown in slides below and related material discussed during the L&MP module), and the most generic issues that arise:

Getting into contract

- You have to deal with people you may not like
- Need to meet face to face to establish relationships
  - Impact of COVID/shift on-line?
- Who argues the hard points – are they managing relationships as well?
- Who makes decisions?
- Look at body language as well as words (written and spoken)
- Beware of culture and humour

With thanks to Patrick Farrant   Taylor Vinters*

Partnering: managing the relationship

- Deal teams and relationship managers:
  - Different people – rebuild relationships and trust
  - Different people see things differently – no shared deal history
  - Same people – soured relationships
- People are not machines
- Dealing with breaches
- Avoiding/choosing when to escalate

With thanks to Patrick Farrant   Taylor Vinters*

Stronger answers

The stronger answers will be able to build on the basic answer by looking at ways in which the generic problems can be overcome (using module slides, plus the discussion of the role of e.g. 'boundary spanners' in building and maintaining partnerships). The stronger answers should also be able to unpack and demonstrate the impact of the key elements of the question, I.e. ".. in conditions of rapid change". The core knowledge that needs to be demonstrated is that most partnerships take time to form – for the reason that trust is slow to build, however strong the contracts are – but sometimes partnerships have to skip steps of the normal process due to, e.g. pandemic, natural disaster, war, etc.

Students will be able to draw upon case study material presented in lectures from company and NHS speakers (see below).
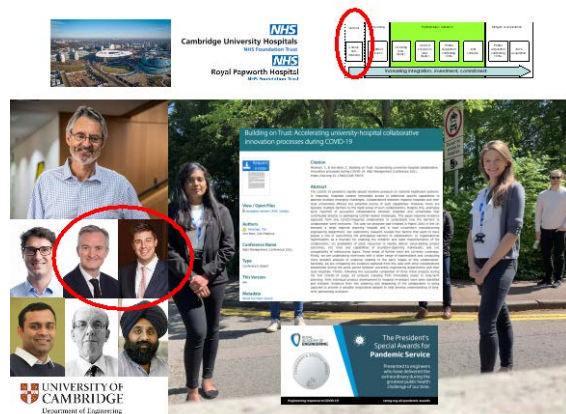
Use of 'boundary spanners', e.g. RAEng Visiting Professors of Innovation

- **Pieter Knook** was formerly Director of Internet Services at Vodafone and President of Microsoft Asia.
- **Sam Beale** was Head of Technology Strategy at Rolls-Royce Group.
- **Rick Mitchell** was Group Technical and Quality Director at Domino Printing Sciences.

Excellent answers

The strongest answers will demonstrate awareness not only of all the issues described above, but also the contingent nature of such partnership formation and development. While some rules are generic, and some steps essential, the cases discussed in the modules show that some can be skipped / modified in extremis, and the results can still be good. The strongest students could also demonstrate the depth of their understanding by drawing in other contextual factors as discussed in other modules, for example, from the TIM module there are plenty of examples of the need to rapidly form (and end) partnerships in response to accelerated technological development cycles and competitive pressures.

Question 4

Ryanair Group, an Irish low-cost commercial airline, was founded in 1984. As a result of the deregulation of the aviation industry in Europe in 1997 and the success of its low-cost business model, the airline is known for its success and rapid expansion. In 2010, the company transported 66.5 million passengers. By 2020, the number increased to 148.6 million passengers, yielding a turnover of €8,495 million. Ryanair's route network currently serves 40 countries, most of which are in Europe. It currently operates more than 400 Boeing 737-800 aircrafts, with a single 737-700 used as a charter aircraft, as a backup. In this context:

(a) Discuss Ryanair's *market life cycle*, providing strategic considerations and
    comparisons with other companies to illustrate your points.

[50%]

CRIB

(a) **Basic answer**s would be highly based on a description of the lifecycle theory
   without much reflection on the specific Ryanair case.
    The lifecycle model shows different stages from introduction, growth, maturity/saturation
    and decline (or stabilization). Stages would be illustrated by examples of companies such
    as Ryanair, iPhone, Tesla among others.
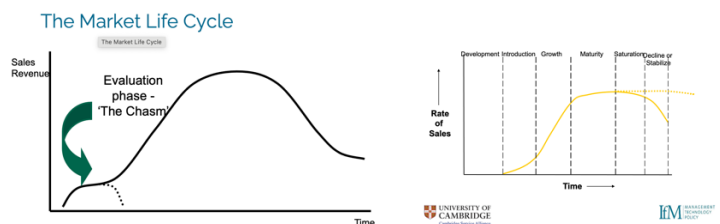
Each stage could be including the typical types of customers-buyers and aspects related to the economic aspect of each maturity stage. The students could describe the types of customers. For instance, the innovators and adopters that will buy the product/service because it is new and innovative as opposed to the conservative customers that will buy the product/service because the product/service has become the standard in the market. Other information based on the lifecycle theory will remark on the price, risk and benefit from each market lifecycle stage. The introduction stage: high price and high risk. For instance, only small number of customers will get benefit from the new innovation to justify the products' cost. In contrast, in the growth stage the production and market acceptance's risk decreased and price has fallen. Therefore, the market has grown and the is the market acceptance as the product/service worth the cost. Finally, the mature stage and decile, the risks (production and market acceptance- are

relatively inexistent). The big difference is that in the mature stage the benefits exceed the cost for a large number of customers and the product becomes a commodity.
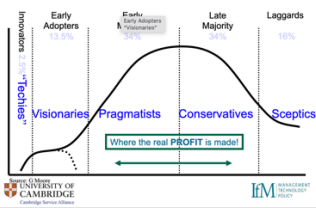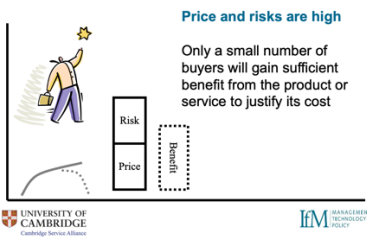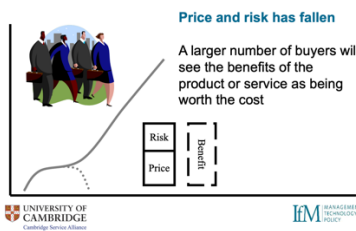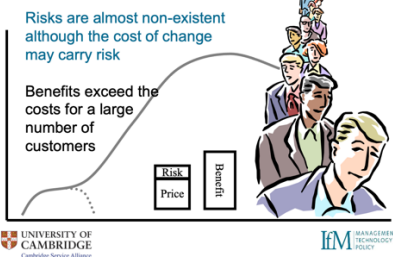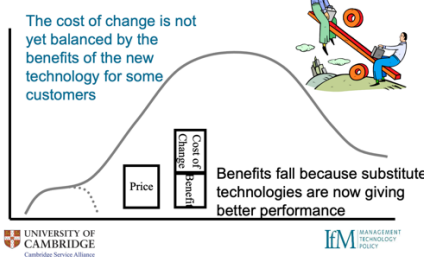
The 'growth' and 'maturity/saturation' market lifecycle stages are the most profitable ones for any company as they attract a great % of the market (there are market acceptance, established supply channels, already developed employee skills and under-control/optimised operational process, systems and technology). For the growth stage, the typical type of customer is made of 'pragmatists' who would buy a product because it provides an improvement in comparison to other competitors and moreover this product/service fits with the current infrastructure that the customer uses.

In the mature stage, knowing your typical type of customers, in this case 'conservatives' is an important advantage because offers are semi-customised for those late adapters. Conservatives are defined, as would consume the product/service because it the standard that almost everybody has adopted. They represent the other 34% of the market. The new products/services pilot experimentations' cost are no longer critical and the product/service is well recognised by the market. In this mature stage, the operations are streamlined, consolidated and optimized across the supply chain. The system is established and the return of the investment comes from serving large volumes of passengers.

Strong answers will deepen the description, including a discussion of the key customers targeted at each stage and of the tactics which might have been adopted to attract them (e.g. developing routes that attract the money-poor – time rich customers first, to test and demonstrate the potential of the new business model to the more conservative audiences). In the growth stage, particularly for Ryanair, the product/services are known. The market kept expanding to new places. In the mature stage, Ryanair consolidated its marketing channels particularly by increasing the number and types of offers to certain destinations. During the growth stage, Ryanair kept expanding the market to destinations that were quite similar to the original ones, but could offer best prices and new adventures to customers, such as expansion to Eastern European countries.

During the mature stage, based on the customer data and knowledge, Ryanair keeps increasing the frequency of flights particularly to those most popular cities during certain seasons. For instance, during summer festivals frequency to certain destinations are increased. Ryanair's examples include:

In the growth stage: new airports for landing and departing were investigated and tested and additional infrastructure was created (to offer alternative transport to users from main city centres to the remote Ryanair operating airports) until the correct ones fit Ryanair's cost leadership business model. Other operations enhanced by the addition of secondary new product introductions are the Ryanair seat selection pre-booking system and luggage system which keeps tight operations and brings an additional revenue to the company.

Best answers The students hopefully recognise that the company is in the maturity (possibly) leading to saturation phase. They will be also delving into discussing the risks and benefits from each of the market lifecycles. Some key discussion on the economics value of each phase and the challenges ahead for the firm might be included, even adding assumptions. For example, these answers would also discuss the benefits the commoditization of mature product/service in established markets. Examples of other companies undergoing or being at a similar phase drawn from the lectures will be included.

(b) Ryanair's low-cost business model is strategically supported by streamline operations and *performance measures*.

    (i)   Explain the four perspectives of the *Balanced Scorecard* and discuss how each perspective contributes to achieving Ryanair's strategic objectives.

[40%]

(b)

(i)

Basic answers should define the balance scorecard as one of the main performance measurement models developed by Kaplan and Norton. The objective of the balance scorecard is to translate the company mission and vision into objectives and metrics to execute the firm's strategy. The four perspectives include: finances, internal business, customer and learning and growth (last one also named people's perspective). In addition, students would be able to explain the four perspective of the balance scorecard – the key characteristics of this model including: balanced set of metrics, financial and non-financial, tangible and intangible, people and innovation. Basic answers would argue that the non-financial perspectives such as people, internal processes and customer would help Ryanair to fulfil its financial targets.

Stronger answers should cover the above plus one or both of the following.

- Detail at least two perspectives of the balance scorecard with the 'objectives', 'measures' and 'targets', as illustrated in the middle slide above shown. For instance, the 'internal business perspective' could be illustrated as follows– objective: On time departure. Measure: % flights departing on-time. Target: 95% on time departures a day. Other examples would illustrate the innovation and learning perspective with metrics including: number of new services released to the market a year and capital expenditure in research and innovation.
- Discuss in detail how individual perspectives contributes to the end/final financial goal of Ryanair. Stronger answers would argue that the diamond shape of the balance scorecard's perspectives is logical path to strengthen the performance for profit companies such as Ryanair. I.e. where the 'innovation and learning perspective' at the bottom' directly enables the two perspectives above 'the customers' perspectives' and the 'internal operations perspective'. And lastly these two enable the final 'financial perspective' of a for-profit organisation through setting the right objectives, measures and targets that are crucially needed in operations and that customers want.

Bests answers should take into account the firm's strategy is likely to be "be a leading low-cost commercial airline and achieving profitable growth for the shareholders". Best answers would be able to connect Ryanair's value proposition as (low-cost) *operational leader* with each of the perspectives of the balance scorecard. Answers should be able illustrate with relevant objectives and metrics for each perspective. Ryanair's operational leader strategy is strongly reflected in the internal business perspective with metrics including: capital expenditure in monitoring fuel performance of flights, number of flights with delays due to system failure, etc.

Best answers would discuss the interdependence of perspectives to enhance/enable the final perspective of Ryanair. For instance, without the fundamental innovation and learning perspective the other three would not be able to exist. In addition, it would be expected that best answers would highlight the importance of 'the internal operations perspective' of the balanced scorecard in particular as a key perspective for 'operational leaders' such as Ryanair (low-cost airline). Other answers would compare and contrast the key metrics of the Ryanair perspectives with other companies such as the metrics of the chocolate factory case or the Dyson case. Strongest answers would critique the suitability and effectiveness of the balanced scorecard for non-profit organisations, including voluntary ones, and will provide alternative performance measurements systems such as, the performance prism or performance pyramid models.

(ii)   Classify the following measures, using the four perspectives of the *Balanced Scorecard*. If you think that some of the measures fit in more than one perspective, explain the logic for their multiple fit.

- Employee satisfaction
- Quarterly sales growth
- Operational cash flow
- Net Profit Margin
- Crew retention
- On-time maintenance delivery
- Percentage of sales per new product
- Percentage of customers who are "very" or "extremely" satisfied
- Number of departed flights on time
- Sales turnover or sales revenue
- Inventory turnover
- % of delay departure due to lack of pilots
- Number of new vs. repeat website visits
- % of market share
- Cycle time variation
- Number of months to develop new product's generation
- % of employees fully trained
- Number of faults measured per unit per flight
- Customer retention rate
- Number of new product-service introductions per year

- % of net profit invested on service development

- EBITDA (Earnings Before Interest, Taxes, Depreciation, & Amortization)

[10%]

(ii)

Basic answers First will correctly classify the metrics into the four perspectives. **Strong answers** will also identify that the *'number of new product-service introductions per year'* metric fit in both the Internal Business (Operations) Perspective and the Innovation and Learning (People) Perspective. **Strong answer**s will on top recognise that the '% of net profit invested on service development' metric fits both the Financial Perspective and the Innovation and Learning (People) Perspective.

Financial Perspective:

- Quarterly sales growth
- EBITDA (Earnings Before Interest, Taxes, Depreciation, & Amortization)
- Operational cash flow
- Inventory turn over
- Net Profit Margin
- Percentage of sales per new product
- Sales turnover or sales revenue
- % of net profit invested on service development (**)

Customer Perspective:
- Percentage of customers who are "Very" Or "Extremely" Satisfied
- Customer retention: retention rate
- Number of new Vs. repeat website visits
- % of market share

Internal Business (Operations) Perspective:
- Number of departed flights on time
- % delayed departures due to lack of pilots
- Cycle time variation
- On-time maintenance delivery
- Number of faults measured per unit per flight
- Number of new product-service introductions per year (*)

Innovation and Learning (People) Perspective:
- Employee satisfaction
- Number of months to develop new product's generation
- Crew retention
- % of employees fully trained
- Number of new product-service introductions per year (*)

- % of net profit invested on service development (**)

Stronger answers will explain the rationale for fitting multiple perspectives. Stronger answers will argue the that the '*number of new product-service introductions per year*' metric fits the 'Internal Business and Operations Perspective' by measuring the performance of Ryanair's product/service design operations. At the same time, the same metric also fits the Innovation and Learning (People) Perspective by measuring the performance of employee's learning and development. Strong answers will use some Ryanair examples of product-service introduced such as, advanced seat bookings, fast track bookings, etc.

Next, the *% of net profit invested on service development* metric fits the 'innovation and learning (people) perspective by measuring the company's commitment to further invest and develop employees' learning. The same metric also fits the financial perspective by evaluating the business strategy monetizing and investments plans.

Best answers will argue by comparing and contrasting that companies with higher investments (as a % of net profit) in product-service development within the innovation and people's learning-are predictors of future financial success and business stability. As opposed to companies using this same metric to evaluate financial performance (metric used in the financial perspective), which characterises them as 'short-term focus' and 'lack of long-term strategic vision'. Other best answers would discuss that innovation and people growth perspective and metrics are key indicators of forward-looking business strategies.

END OF PAPER

Question 5

You have been appointed as Open Innovation manager at BigPlayer plc., a large consumers good company, operating internationally. The mission of the company is to "improve the lives of customers now and in the future, caring for the health of the environment". In your role, you are supporting the New Product Introduction (NPI) process for two different categories of products (homecare and healthcare). The company aims to innovate in at least 50% of their products and your job is to provide access to technologies which help the company fulfil its mission, grow their market and reduce production costs by 2035.

(a) Making assumptions whenever needed based on the above scenario and by building on your understanding of Open Innovation and of the New Product Introduction processes in large multinational companies, discuss how you would expect the company to be organised to innovate and explain what your role will be within it.

[40%]

(b) Based on your answer in (a) and on your understanding of the Technology Management processes, explain how you plan to carry out Open Innovation activities to:

i.   identify new technologies and opportunities for the two categories of products mentioned above.

[20%]

i.   select the most promising technologies.

[20%]

ii.   acquire the selected technologies.

[20%]

For each, justify and give appropriate illustrative examples of the methods you would like to implement, explaining the practical initiatives you would introduce.

CRIB
Several elements in the TIM lecture week provide support to answer this question. Here below one is proposed. However, the quality of the answers will be judged according to the capability to link across the various lectures which discuss the TIM processes and the ability to provide plausible examples of implementation of the theory. The basic answers will have a more descriptive content, whilst good and excellent answers will demonstrate to be able to connect aspects linked to innovation but presented across the MET course and to provide very good examples of which practical approaches to introduce.

(a)

Basic answer. At a minimum, the innovation funnel should provide the key elements, to start imagining the company's innovation process. The company is likely to represent their innovation processes using a funnel shape, like that described in Fig 1. The basic answer might attempt to describe this funnel, explaining that at the start (also called the fuzzy front end) methods will be required to develop many innovative ideas to target the key ambitions

(i.e. ideas to increase market opportunities or to reduce cost). Examples on how the company deals with the generation of many ideas and the testing and filtering out of these ideas might be inserted in the answer. Towards the end of the funnel the ideas will need to be implemented and hence the process requires more discipline. Different project management approaches could be employed to move ideas towards commercialisation, relevant to NPI (Cascade product management vs agile methods) and the candidate might refer to those.
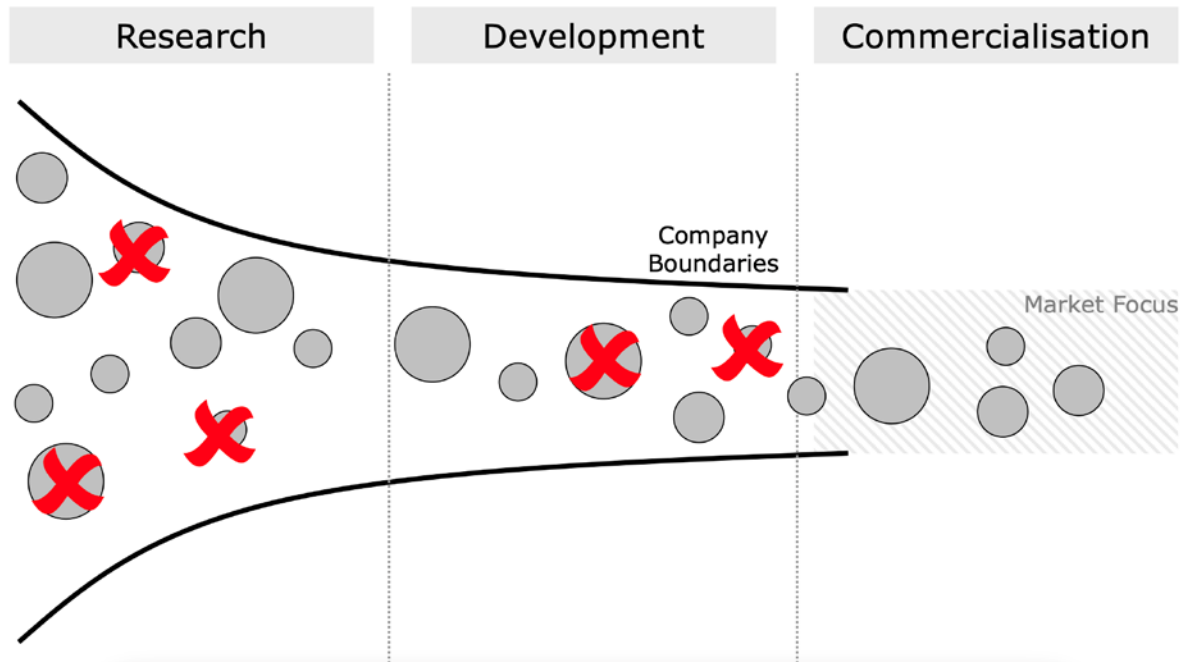

Fig 1

The company is certainly adopting open methods since the candidate has been hired as Open Innovation manager. Hence the funnel would resemble more that in Fig 2, rather than the closed one in Fig 1. As an OI manager, the candidate is likely to be asked to identify routes to acquire inputs from the outside of the firm at several points in the funnel. The sources of technologies (external competences) could be many, including users and consumers, startups, universities etc…

There might also be routes where the company innovation ideas are 'sold' to others (e.g. via IP licensing), although these are likely not to fall under the responsibility of the OI manager.
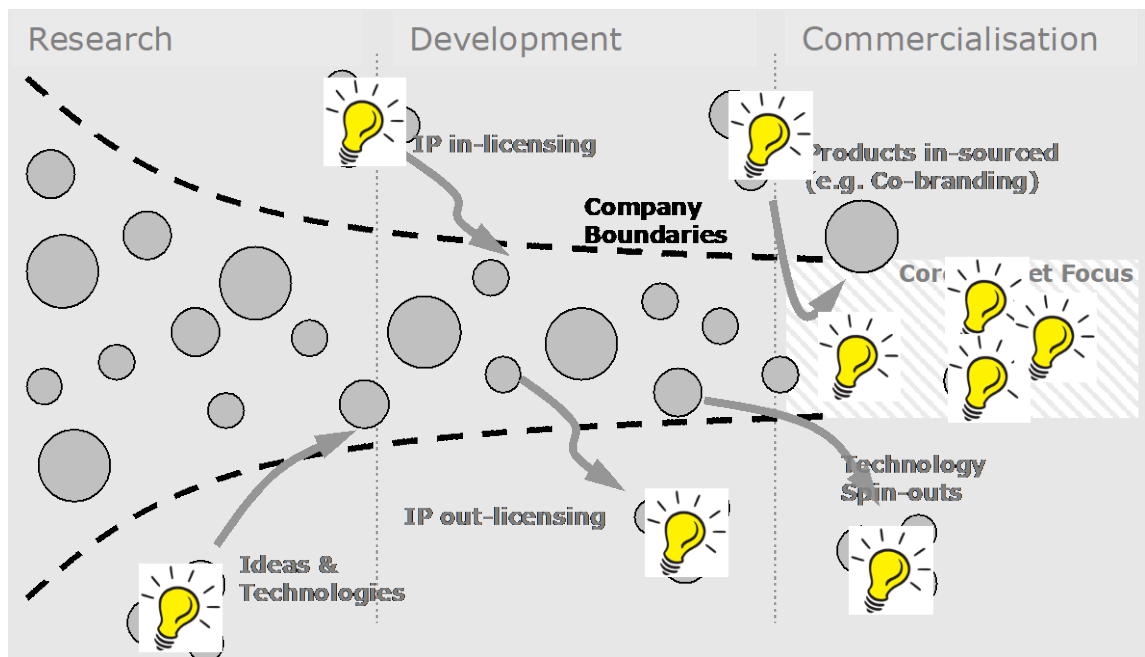
Fig 2:

Good answer The innovation funnel should align with the company strategy (In the question, a strategy aim is provided by the mission statement of the company,) hence the NPI of BigPlayer plc. is geared to create products that improve the life of customers whilst caring for the environment – it is hence expected that to launch new products in both categories, the OI manager will have to attempt to identify and acquire technologies that enable products with such potential. Hence, following the Penthatlon framework (fig 4), a good answer would then recognise that an OI manager is expected to keep connected to the processes in the company that update the strategy (e.g. roadmapping), to make sure that s/he helps contributing to important (and possibly evolving) goals of the firm. Here some consideration on how the company might be considering ambidexterity (striking the balance between exploration and exploitation) might complement the discussion on the link between innovation/NPI and strategy.

The candidate might also recognise and expect several funnel pipelines for each line of business. (Fig 3) (e.g. for growing the market – homecare, growing the market – heathcare, reducing costs –homecare etc..)
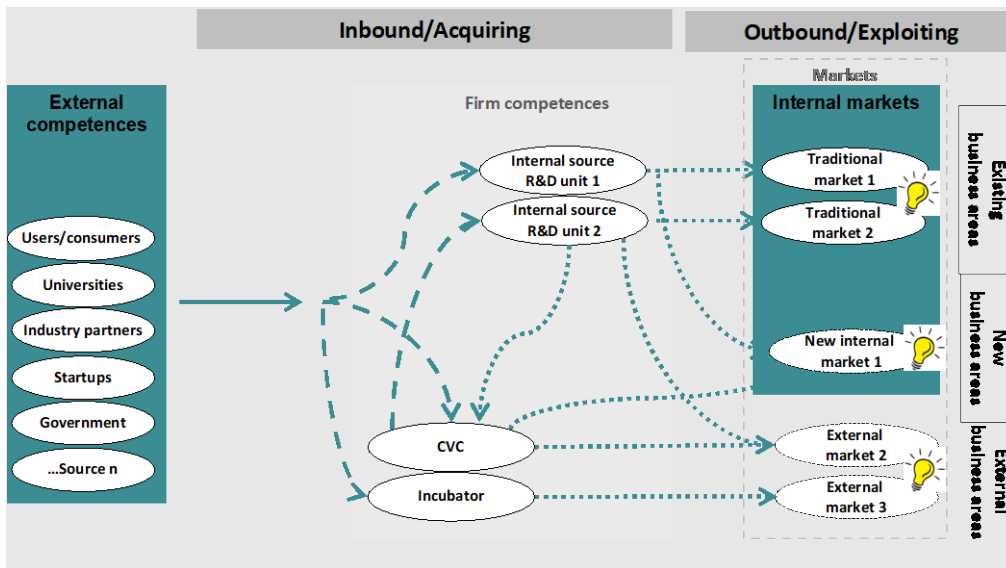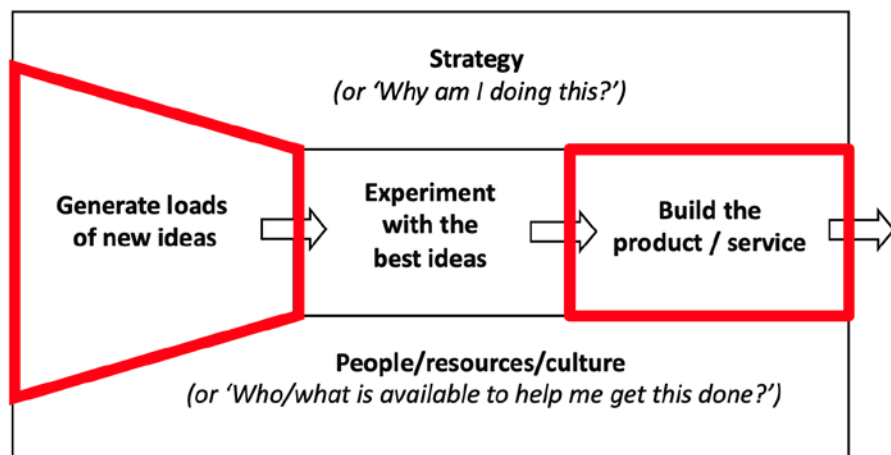
Fig 3.

Pentathlon Framework

Fig 3.

Further, as there are many innovation funnels expected (e.g. for the different categories, for each type of product or process) and as each funnel adopts different principles at the start (fuzzy front end) and at the End (to implement the innovation and commercialise it), the OI manager will have the challenge of involving people across different roles (R&D, Operations, legal etc.). This means s/he will need to understand how to establish a culture which promotes innovation and is supportive of trial and error approaches to guarantee that the development of the concepts in the FFE, and methods that take into account the needs of the manufacturing, marketing legal and other departments to implement the innovative ideas.
So, the OI manager should make an effort to appreciate the requirements of the different people involved and try to understand their motivations and build links across the various functions, in conjunction with the colleagues who manage the NPI

processes. Here some elements from the managing people module might appear. (eg fig 5)
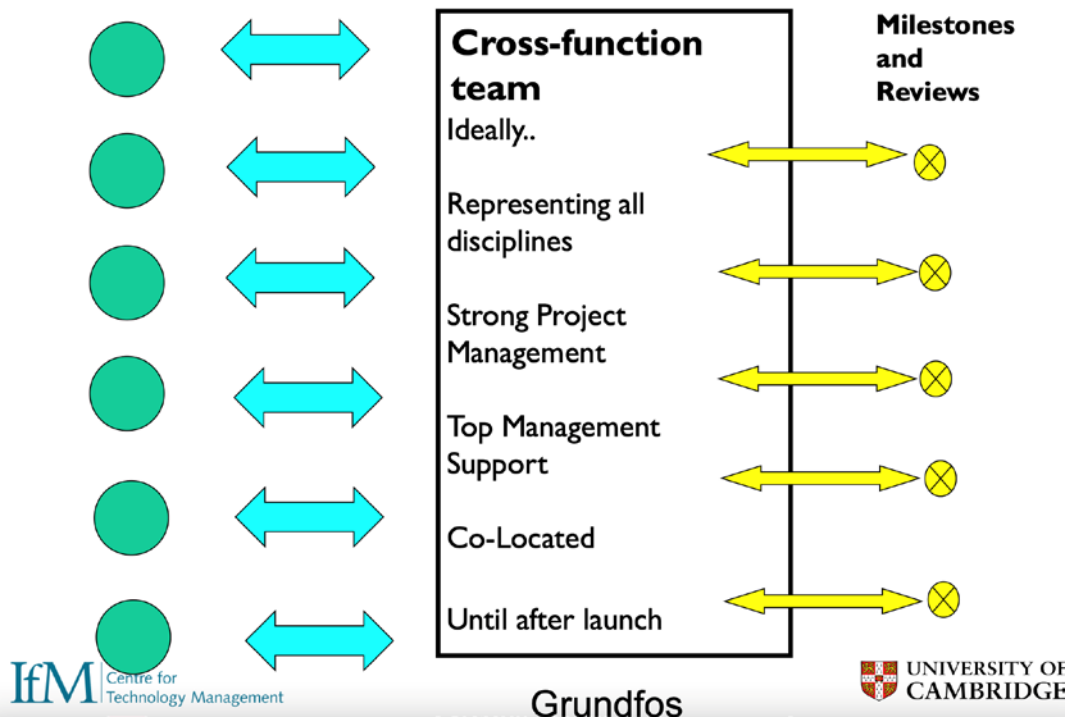

Fig 5: concurrent engineering in NPI

Excellent answer: Will step up from the material directly provided by the lectures and will envision some of the key activities and issues faced. For instance, the candidate might recognise the problem posed to the company and the OI manager of striking a balance between open and closed activities. The OI manager would need to be clear about what technologies/innovations should be developed internally and which instead should be sought externally. This framework guides the actions in part b. The most sophisticated answers would demonstrate a deeper reading of the extra material provided on OI, for example they will mention that some companies might have centralised OI teams which serve the whole firm, whilst others might have OI activities specific to each unit and hence the candidate might hypothesise where the OI manager is working. Further, another thought might be given to the maturity of the implementation of OI (is the role of the manager that of establishing a set of OI processes, i.e. the skills, motivation, culture, new to the firm and so would meet resistance? Or is s/he fitting within a larger already established OI team?). How is the company evaluating the success of OI? How are the people motivated to carry out OI?

B) As per the question above, the quality of the answer will be defined by the increasing capability not just to recall elements and examples shown in class, but to be able to match

the theoretical understanding with plausible examples. This part of the question will build on the previous one and will illustrate techniques which can be used by the OI manager to:
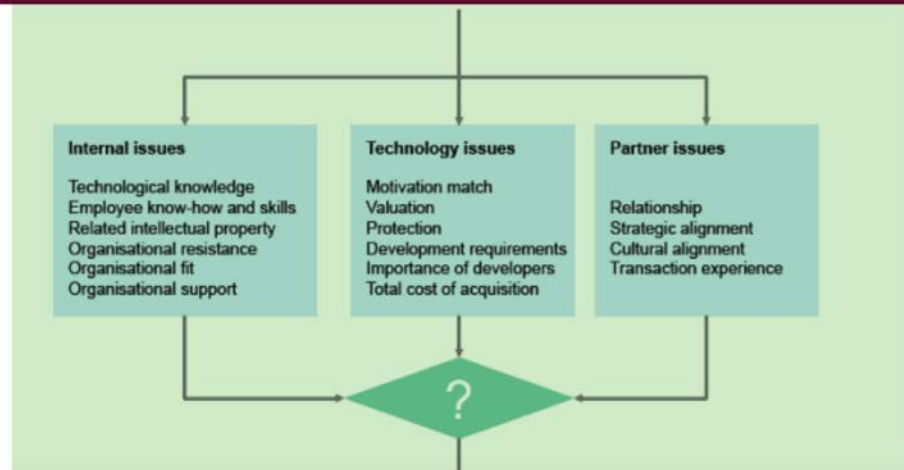
i) Identify:
   a. Basic answers: building on the technology intelligence (TI) lecture, students should be able to describe the theory – e.g. the 4 modes of searching information (Mine, Trawl, Target and Scan) and the TI process model. In particular, as the OI manager is looking for ideas externally, it would be plausible that the manager would be concerned with "targeting" certain technologies in particular. Building on this framework,
   b. A Good answer, as requested by the question, would add some consideration which would make the approaches more concrete. For instance, the students might mention that to target it is important to develop a "want sheet" which helps considering which technologies should be targeted and which sources of information should be tapped.

Core components of the 'technical solutions' Want sheet:

Source: T. Belmar 2012, H. Barraza, 2012
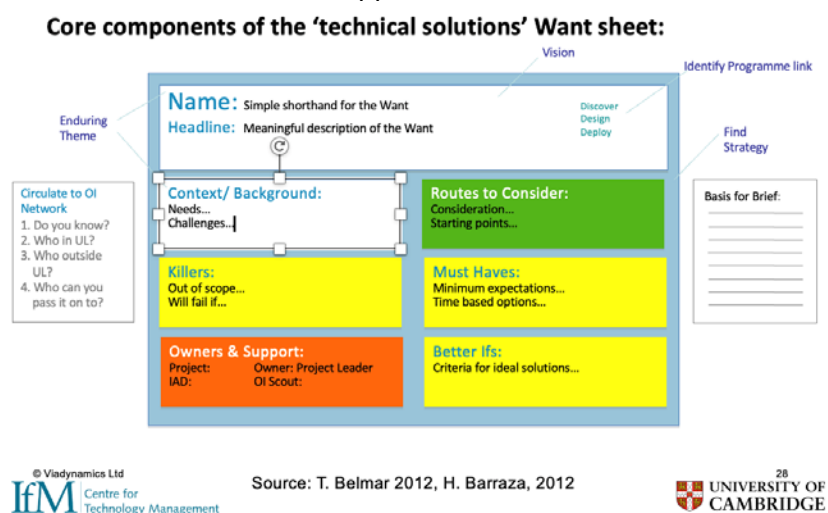
   c. Excellent answers, on top of the above, should recognise that the OI manager serves different parts of the OI funnel (so several want sheets might be adopted) and that different sources and methods might apply. E.g to identify ideas to support the the Fuzzy front end, techniques to call for ideas might be appropriate (e.g. Crowdsourcing), whilst to identify specific IP which could be useful, scouting to reach out to start-ups or analysing patents might be appropriate methods.

ii) Select:
   a. Basic answer. Mentioning some of the theory. The 'feasibility' vs 'opportunity' scales, provided in the selection class would provide a good basis for answering this question. Mentioning some examples of criteria which link with the case presented regarding opportunity (growing markets, reducing costs, and sustainability) vs the challenges of feasibility (e.g. working towards higher TRL).
   b. Good answer. The answer will hint that the feasibility/opportunity scales above link with the need to triangulate between the three aspects (quality of the technology, partner issues, and internal issue). So there are not only technology issues to be considered during selection, but also issues related to

partners , to the company's capability to work with them as well as to the ability to absorb the external knowledge.

2. Assessment of the match

Internal issues

Technological knowledge
Employee know-how and skills
Related intellectual property
Organisational resistance
Organisational fit
Organisational support

Technology issues

Motivation match
Valuation
Protection
Development requirements
Importance of developers
Total cost of acquisition

Partner issues

Relationship
Strategic alignment
Cultural alignment
Transaction experience

?

    c. Excellent answers will demonstrate the links between selection elements presented across the lectures and a capability to imagine real examples of selection methods and criteria which can be used. The selection methods should lead the managers to prepare the way to design appropriate acquisition approaches, so considerations about the interaction with different types of partners (Start-ups, universities etc..) vs the internal capability to absorb the knowledge (e.g. mentions of not invented here syndrome) will appear.

iii)   Acquire:

    a. Basic answers are likely to mention acquisition configurations (e.g. governance modes, technology progression to a higher TRL, what is given in exchange to partners), as a list form.

    b. Good answers would link these configurations with the need for the manager to have a clear plan for acquisition and the motivation for acquisition (Why do we want to acquire the technology?). E.g. the make vs buy framework will help describing the link to the reasons why the company is trying to acquire, what development to keep internal what is looked for externally (e.g. partnership - OI vs do it internally). Further the previous understanding how how different types of partners work (e.g. universities vs start-ups) might allow to configure the best governance modes for the relationship.

    c. Excellent answers will be able to explain how acquisition connects with protection and exploitation (e.g. exploitation is implicit in the case described – the company produces home and healthcare products and is likely to make money by selling these in the market. Considerations on how to be able to secure a competitive advantage based on new technologies introduced via the OI acquisition, would play part in the negotiations of the terms of acquisition. So thoughts about the management of IP is important in the stage of acquisition).

QUESTION 6

Question 6

The UK imports nearly 100% of all smartphones. In line with its net-zero target, BT (British Telecom Plc.) has recognized this as a business opportunity. BT decided to develop an innovative smartphone that can be manufactured in the UK with much lower emissions. You have been appointed as the Chief Sustainability Innovation Officer (CSIO) in charge of the "smartphone of the future" project. Your aim is to maximise eco-efficiency.

A). Using examples, explain how you could adopt two eco-efficiency principles each when designing the following:

1. the smartphone;

[20%]

2. the factory to produce it.

[20%]

B) As the price of Lithium - an essential material for smartphone batteries - has been soaring, you have searched for alternatives. You identified a university spin-out that has developed and patented a sodium-based alternative including a manufacturing process that allows for cost-efficient battery production at scale.

Discuss the advantages and disadvantages of the following three *technology acquisition* routes. Explain which one you would prefer and why. State any assumptions clearly.

- Purchasing the company;
- Acquiring a license with 4-year, worldwide exclusivity;
- Acquiring a non-exclusive license.

[60%]

END OF PAPER

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1)

Answers are expected to reveal that students are aware of the eco-efficiency principles as presented during the lectures. The list includes seven principles in total based on work from the World Business Council for Sustainable Development (WBCSD). These include:

i)   Reduce material intensity of goods and services
ii)   Reduce energy intensity of goods and services
iii)   Reduce toxic dispersion
iv)   Enhance material recyclability
v)   Maximise sustainable use of renewable resources
vi)   Estend product durability
vii)   Increase the service intensity of goods and services

Students will be expected to pick at least two principles, which they need to use for both (1) and (2). However, students can also select two different ones for (1) and/or (2).

Basic answers briefly, but without too many details, explain the chosen eco-efficiency principles, but do not provide a reasoning for why they have chosen the two principles. Students would then provide very basic examples of how these can be applied to (1) the smartphone design and (2) the factory design. Examples provided in basic answers might appear to be fairly generic with a low level of detail and depth. The examples might not specifically illustrate how the principle exactly link to the smartphone, respectively factory design.

Good answers provide sufficient level of details when explaining the chosen principles, then provide more advanced examples that make it sufficiently clear how the respective eco-efficiency principles link to (1) and (2). An example of a good answer might read like "BT could use advanced AI technologies to drive down its energy consupltion of the factory. They could follow companies such as Google, which employed Deepmind to further reduce the energy intensity of its data centres. Despite the fact that these data centres had already been highly optimised for energy efficiency, using Deepmind reduced energy consupltion by another 40%. "

Excellent answers provide a much richer explanation of the chosen principles and convey that the students have acquired an in-depth understanding of the eco-efficiency principles and can establish clear and detailed links between their examples and the principles. Answers are likely to not only focus on the same two principles for (1) and (2) but students might decide to work with three or even four of the principles. Excellent answers would be expected to reveal why the students have chosen certain principles for (1), respectively (2) as some of the principles lend itself more for product design, respectively factory design.

2)

All answers two this questions are likely to have two parts. The first part should focus on the comparison of the three acquisitions options. The second part should focus on the recommendation.

Basic answers are likely to provide only a fairly high-level comparison of the three acquisition options in generic terms. Basic answers will have to provide a recommendation, but that recommendation might only follow loosely from the comparison. Basic answers might have blurry boundaries between the first and second part of the answer.

Good answers will be more structured with an introduction, possibly followed by a first part that focuses on the comparison of the three options, then followed by a clearly separated second part that focuses on the recommendation of the most suitable option. In the first part, a good answer, most likely in a narrative style only (i.e. no supporting tables or figures), would be expected to provide at least one advantage / disadvantage for each of the options, which might not, however, constitute an in-depth comparative analysis. The second part might display some logic of how the recommendation follows from the comparison, but this link might not be particularly strong and clear.

Excellent answers will provide more and more in-depth advantages/disadvantages for each of the three acquisition option, but also will be much more specific, possibly even provide examples. Excellent answers are highly likely to be much better structured, possibly even use a table such as the one below as an instrument to provide a more effective answer. For an answer to be considered excellent, the recommended option needs to follow very clearly and logically from a detailed and rich comparative analysis of the three acquisition options.

	Purchasing the company	**Acquiring an exclusive license**	**Acquiring a non-exclusive license**
Advantages (examples)	- Secures full control over the use of the technology and its IP - Ensures full access to the knowhow to fully implement the technology.	- Ensures that others cannot use the technology at least for some time, so provides a time-limited competitive advantages. But will 4ys be enough considering the time it actually takes to build a new factory?	- Likely to be the cheapest option - Easiest and probably fasted option to agree on
Disadvantages (examples)	- Potentially the most expensive option - Might be a more lengthy process than negotiating a license of some sort.	- The company might be unlikely to agree to this as it would wan to commercialise the technology with other partners	- Hardly provides a competitive advantage as others can also use the same technology