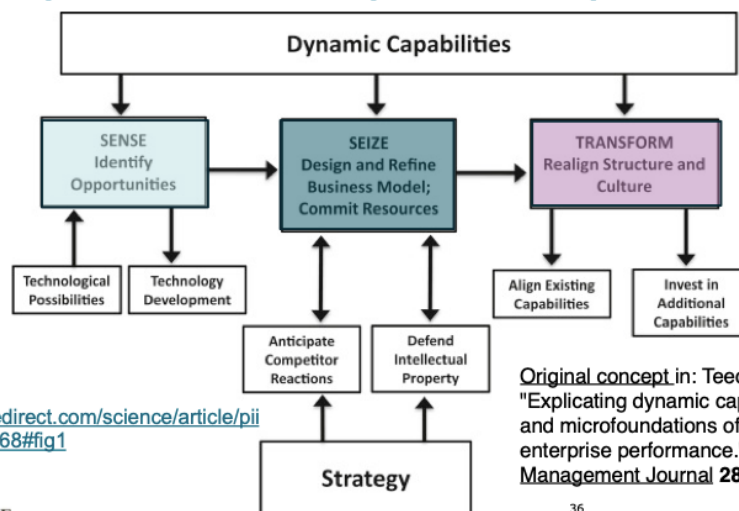


- a. Explain what is meant with *dynamic capabilities* (Teece, 2007), illustrating why these capabilities are relevant for companies and how the main concepts discussed in the *Management of Technology* module align with them. [30%]

This question requires: 1) to recall the element of the course which explains what dynamic capabilities are (a definition-description) demonstrating comprehension regarding their importance and 2) to extrapolate the link between the concept with the elements discussed with regards to the Technology Management tools and practices. The basic answers will be rather schematic and potentially incomplete. The best answers will show structure and clarity evidencing a strong understanding of the fundamentals of Technology Management (why TM is important and what is the role of each of the aspects covered in the course). Ultimately the answer builds on the slides

Dynamic Capabilities allow companies to adapt!



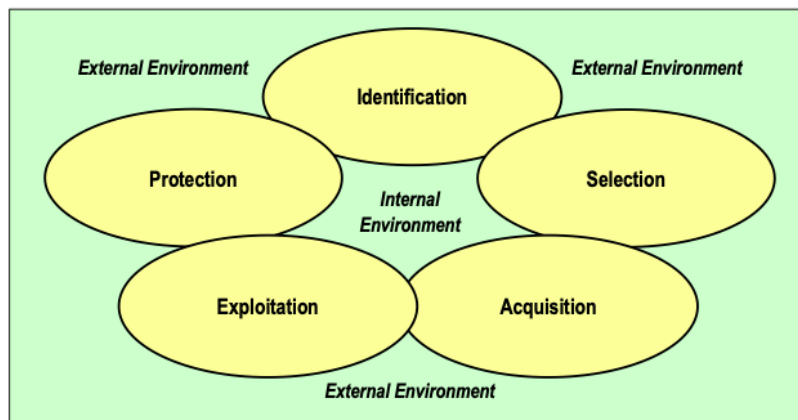
Teece, 2018

<https://www.sciencedirect.com/science/article/pii/S0024630117302868#fig1>

Original concept in: Teece, D. J. (2007). "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance." *Strategic Management Journal* 28(13): 1319-1350.

And

There are 5 technology management "dynamic" capabilities



Dynamic capabilities describe a firm's ability to sense emerging technological opportunities, seize them through timely and well-governed decisions, and reconfigure its assets and processes as conditions change.

As the environment is in continuous change, companies need dynamic capabilities to adapt, continuously, building new competencies (i.e. new key technological and knowledge assets), to ensure long-term survival and competitiveness. Rather than disappearing from the market if their products do not fit the market need, through DC they proactively manage to adapt to external drivers and changes, they can develop next-generation products, processes, services, and leap onto innovation cycles, (i.e. they can innovate). The dynamic capabilities are:

- Sense: identify and anticipate new opportunities and threats in the environment, including technological developments and competitor actions.

TM links: Through *Technology, Market and Competitive Intelligence*, in conjunction with *strategic planning activities* (e.g. though Roadmapping, Scenario planning exercises) companies can interpret the signals in the environment and identify the opportunities and threats approaching.

- Seize: strategies, and approaches to capture identified opportunities and avoid threats.

TM links: This includes *selecting* the right resources to complement current assets, *acquiring* (i.e. deciding whether to acquire from external partners or develop internally), deciding how to *exploit* new competences in products and services (or new product lines), through the design of new business models, and

how to fund the development of new competences, how to *protect intellectual* property and aligning new initiatives with existing organizational structures.

- Reconfigure: The capacity to reconfigure the organization's asset base and structures rapidly enough to jump onto new trends.

TM link: This is a complex act with is supported by systematic *strategic planning activities* (e.g. the use of *roadmapping* which helps to plan the links and how the assets in different views across the company – technological / product and services / market will be developed) and activities and processes which manage the execution of the plans (e.g. *Innovation* and *Operations Management*)

b.

You are part of a consulting team supporting MedTech Solutions Ltd, a medium-sized firm that develops diagnostic devices for hospital and home-care markets. The company faces significant uncertainty about future trends and is worried about different aspects including the adoption of digital and AI-enabled diagnostics.

The company's senior management team recognises the need to take a longer-term, structured view of how markets, technologies, and capabilities may evolve, and to develop a coherent plan but lacks a method to do so.

- Based on your knowledge of technology management tools, advise the senior management on how they could develop an approach that combines *scenario planning* and *technology roadmapping* tools to support their strategic planning. Discuss the value of the tools and, where appropriate, illustrate the approach with sketches. [40%]**

- This question encourages the design of a tailored activity which supports the firm to design new plans in the face of an emerging technology. Elements for this have been given throughout the course (in particular on strategic planning and the case study at the end of the course).*

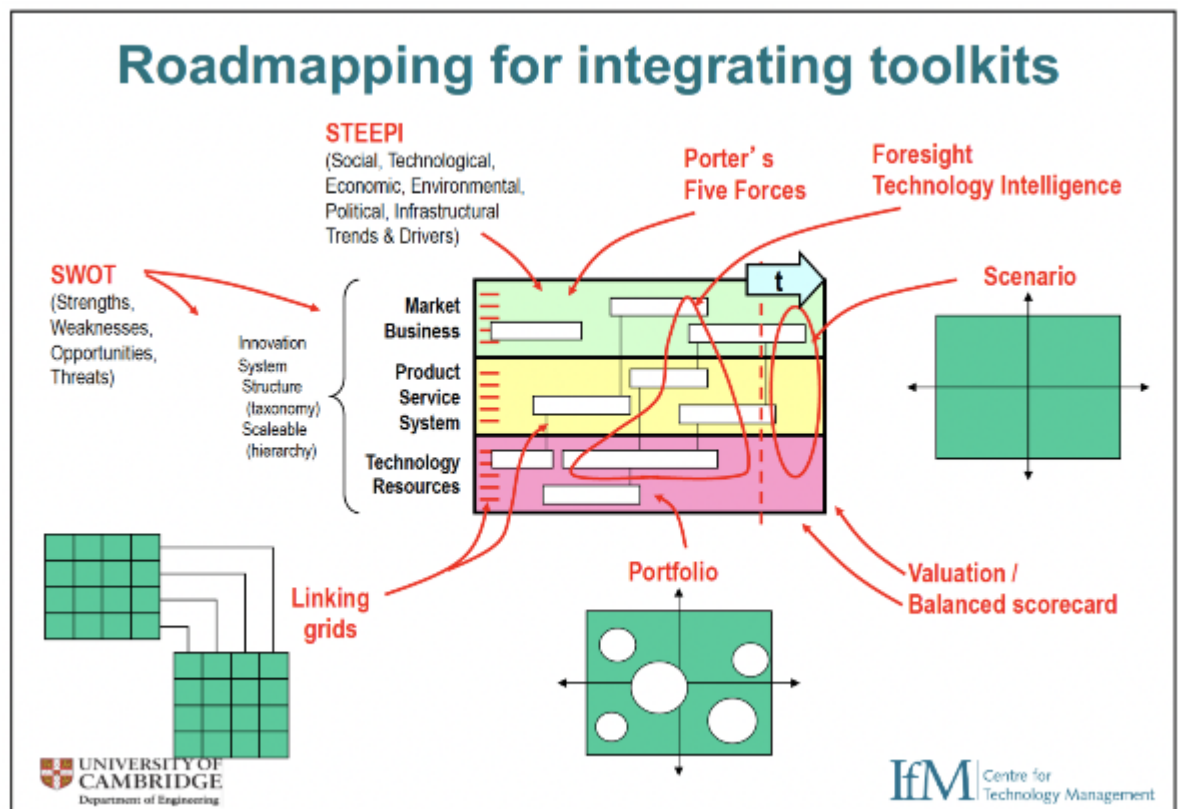
At a minimum, the answer should recognise the role of the different tools identified in the question and illustrate basic elements for deploying the techniques.

More sophisticated answers will include the explanation of the approaches in practice (step by step) and a clear description of the elements in each technique.

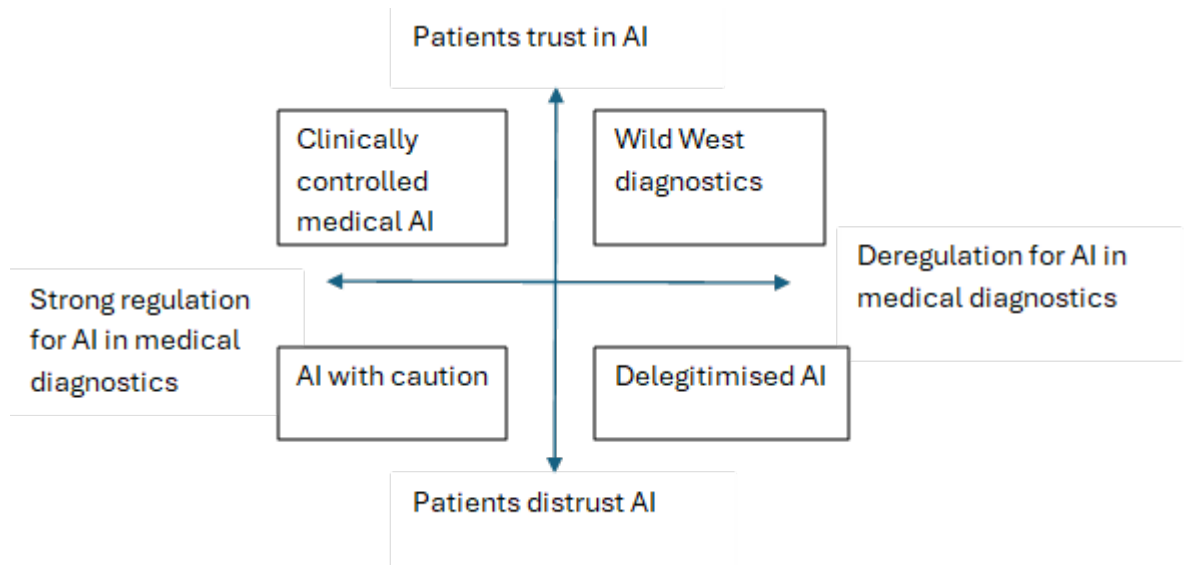
Scenario planning = helps with exploring alternative futures, addressing deep uncertainty; avoiding single-point forecasts

Roadmapping = for each of the scenarios, through roadmapping one could link the evolution of markets, with plans about products, technologies, and capabilities over time

Given the different roles and objectives, it is possible to combine them (as illustrated in the slide below) to explore and develop strategies for uncertain contexts.



Using scenario planning, the company could discuss the key most uncertain aspects (i.e. those aspects the company has no control over and where trends are highly unpredictable) that may drive the future in AI-enabled diagnostics. Several uncertainties could be identified and (paired) to form the basis for a 2x2 matrix. (e.g. patient acceptance and regulatory frameworks could be the chosen axes - but many other types of uncertainty might be used). Doing so it is possible to identify 4 very different future environments where the company may need to operate in the future. For example:



Each scenario might be used as the background for a different roadmap.

Here the best answers could include the design of a roadmap example and discussion elements about its role, how it could be brought together. For example:

- How the roadmap could promote a structured discussion about the future in a scenario, to help reaching consensus about a Vision for what the company should do in that scenario. This could be placed at the right side of the roadmap.
- How it could help define time horizons (in that scenario, is this vision going to be 3, 5 or 10 years in the future?)
- How it would help expose assumptions and gaps and support communication across different perspectives in the company (for this it might be good to involve decision makers in different relevant areas of the firm (R&D and technical, Marketing, etc..))
- How it could help set priorities for investments and identify gaps in knowledge (i.e. what to keep monitored to understand how the world is moving – this is hinted in the second part of the question)
- How (given new information gathered), it would be important to refresh the exercise regularly, to update plans as the uncertainties shift

- ii. You advise that the company needs to make an ongoing effort to keep up to date with the trends in the AI-enabled diagnostics environment. Suggest an approach for accessing different *sources of information*, discussing their role, pros and limitations.

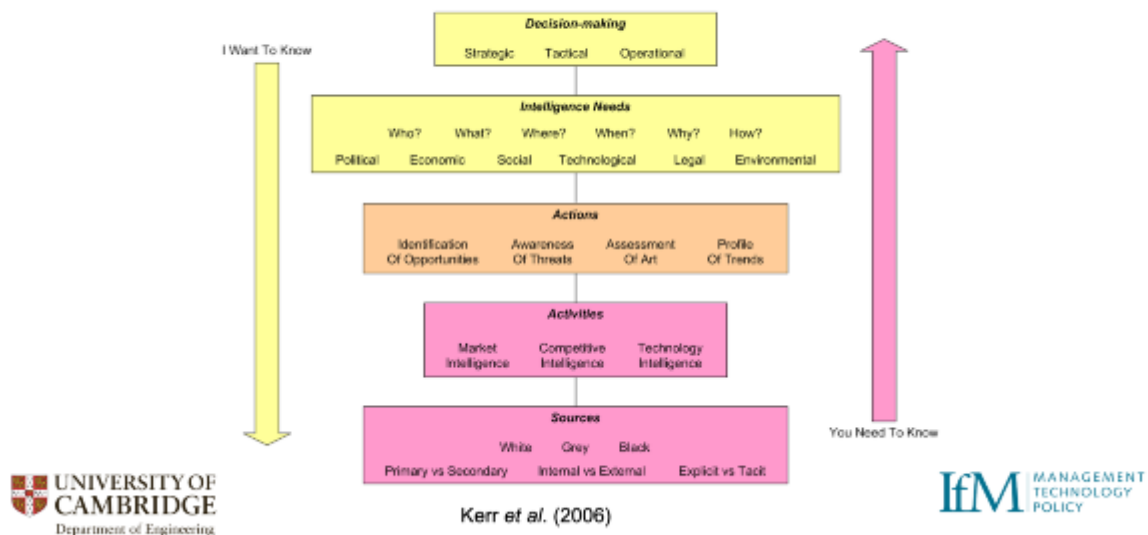
[30%]

Cribs 1.4

This question relates to the design of an intelligence system to reduce the uncertainties, considering which sources of information exist and their roles, pros and limitation. This question is also referring to an exercise which was held in class based on another company/ a different technology. Helpful slides discussed in class are below. The candidates should be aware that there are different types of information sources (Explicit (i.e. published), tacit (people)/ white, grey, black/ primary and secondary (i.e. intermediaries)) and should be able to report and discuss the role of each, their pros and limitations.

The best answers will contextualise the discussion about the sources of information and not just use the generic terms. Further, based on the type of company (medium established/medical devices-high tech/highly regulated environment), the best answer will explain their choices making assumptions.

Overview on Intelligence



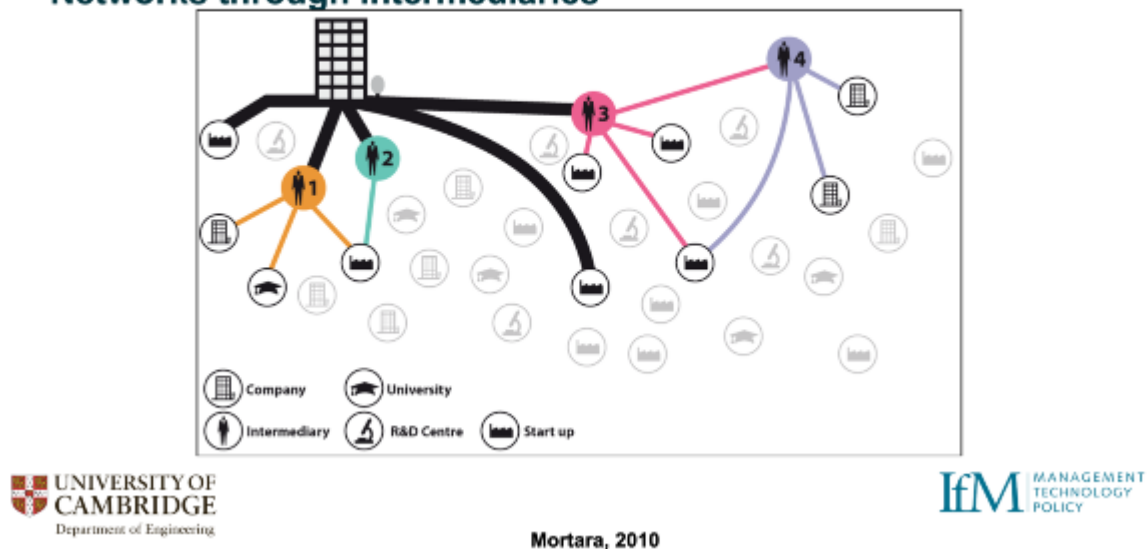
Sources of information

People	Company experts Librarians Technologists Sales/marketing Business developers	Other companies Universities Research centres Government Consultants Forecast study groups
	Internal virtual social networks	External virtual social networks
Documents	Company archives (databases, files, reports, notes, presentations) Libraries Personal archives	Databases (patents, journals...) Public archives Private archives* Libraries Websites
	Internal	External


 Espionage – not intelligence
 Mortara (2006)


 MANAGEMENT TECHNOLOGY POLICY

Networks through intermediaries



For example: As the company is interested in a new area where the uncertainty is high, it is fair to assume the company does not have much prior knowledge about it internally. Hence the sources of information which need to be tapped are mostly external. Black sources refer to espionage, so they are illegal to tap.

The approach needs to triangulate different types of sources, to understand how the state of the art in the area is evolving, especially considering the types of uncertainties highlighted by the scenarios and considering how medical diagnostic is evolving. Further the development of the network should make use of primary sources of information (direct contact with experts/or access to published sources of knowledge) vs the creation of a network through

Cribs 1.4

secondary sources (intermediaries). The discussion of the specific sources (the logic used and the considerations for pros and cons) could for example be:

Explicit/primary(published/white)	Patents in AI for medical (Role: might help identify players in the area)	Pros: available worldwide, possible to use to determine trends (e.g. number of patents by countries, draw s- curves and spot players) Con: As AI is a rapidly evolving area, patents alone might not be very significant (many companies might prefer trade secrets)
	Academic Journals (role: might help identify university advances in medical diagnostics and inform about possible university partners to develop AI-diagnostic products)	Pro: widely available Con: due to the lag in submission- publication, might not represent the most up to date resource. Technology might be very speculative and early TRL. Experts who work with companies might not publish due to industry requirements.

Secondary/Tacit/Grey	Work with an intermediary (e.g. VCs) to identify interesting startups in the area	Pro: VCs could have a sense of what is bubbling up in the area and startups have likely technology with high TRL. VCs might have a sense of how the future market might pan out (they might have knowledge about regulation in different parts of the world)
Primary/Tacit/Grey	Connect with governmental (national and international) experts (e.g. medical councils/ commissions) that inform ministries	Pros: might know the likely approach taken by their countries in regulating AI for diagnostics Cons: Might be very geographically bound
	Etc...	

b. NeoDrive Systems Ltd is a medium-sized engineering firm supplying electric drive systems to automotive customers. The company has historically competed on mechanical and power-electronics engineering excellence, reliability, and close relationships with customers (large automotive firms). NeoDrive currently has strong mechanical and electrical engineering capabilities, limited embedded software expertise, established manufacturing operations, moderate financial resources. A key customer has indicated that future contracts will increasingly depend on advanced control software and data-driven diagnostics integrated into drive systems.

NeoDrive's senior management must decide how the company should proceed to establish this new technology competence over the next 5–10 years.

- i. Discuss how NeoDrive could use the *Make vs Buy* framework to decide whether to develop the new control-software and data-driven diagnostics competence internally or externally. [40%]**

This question requires an application of the Make vs Buy method.

At a minimum, the answers will be based on the core axes that define the importance and competitiveness of the technology (based on the slide below).

1. Technology importance to the business / capability and its future influence --> key success factors (how this tech will influence the company future strategy to maintain a competitive position through product differentiation) - High importance technologies require greater caution when outsourcing. In the case context, it is ok to assume that this technology will be very important since the current customers are pushing for this – e.g. they might have heard that other companies are offering it and might threaten to leave NeoDrive.

2. The competitiveness is an evaluation of internal capability relative to that of Competitors and Suppliers (include for instance expertise depth, learning potential), particularly in the eye of the customer.

As the question asks for a discussion, the (main) strategic options in front of the firm (high importance and clearly weak internal capability) should be covered. What are the advantages and limitations (in this situation for an internal development (i.e. initiate internal R&D? Buy a company altogether? Develop a strategy to partner and find a co-maker?). Best answers will recognise the importance of the learning in this environment (difficult to buy something without understanding it!)

Possible generic strategies are suggested by the matrix...

		Importance to Business		
		High	Medium	Low
Competitive position	Strong	Continue to invest Maintain capability	Consolidate Keep pace	Open options Further analysis
	Neutral	Invest Develop	Partnership	Stop Outsource
	Weak	Initiate R&D Examine for investment or cease, find comaker	Partnership	Stop/Monitor Sell/license Design out find commodity supplier

- ii. Assuming NeoDrive decides that developing the capability entirely in-house is not appropriate at this stage, based on your understanding of the *open innovation inbound/acquiring process*, explain how NeoDrive could proceed to access the required technology externally. [40%]

This part of the question, transitions towards the operational aspects related to the acquisition of the competences from the external world. Students have received variety of frameworks in the Acquisition lecture on which they can build to describe the process that might be followed. This gives students freedom to build on a broad range of material and configure it. Their ability to apply them to the case study (logic and clarity, contextualisation) will be evaluated.

For example, starting from the “acquisition process” they could explain how they

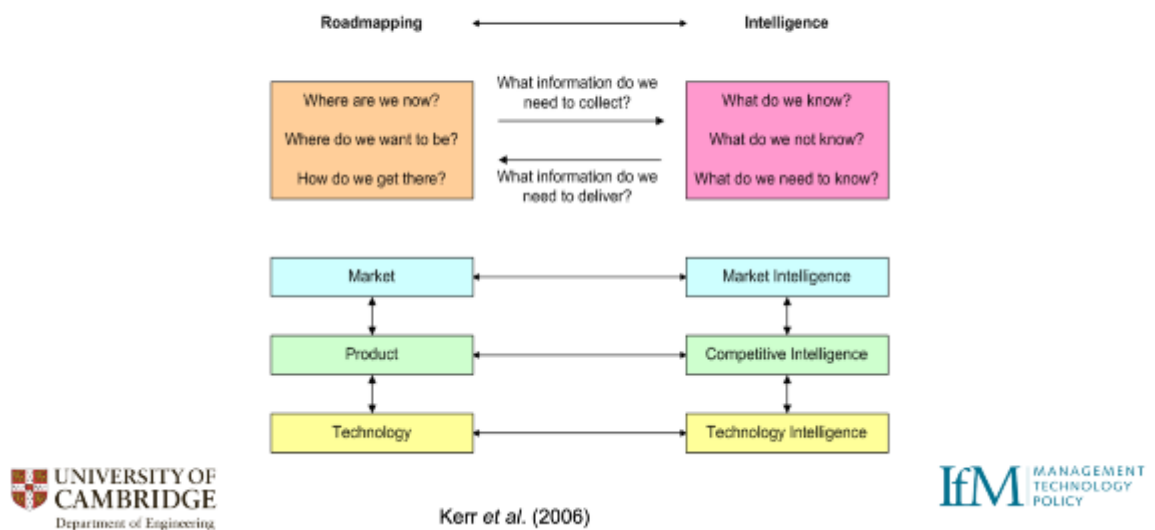
- Define the acquisition context,
- assess the acquisition target and
- design the acquisition terms

For each, they could pragmatically discuss examples of how they would:

- define what the company wants (e.g. creating a clarification about what is needed internally, based on the examples presented in class and the extra material shared),
- Search for this knowledge (e.g. using scouting or via competitions or intermediaries),
- Select the best options (e.g. using the ‘assessment of the match’ method)

- Configure the collaboration acquisition options (How do we progress the technology maturity? How do we regulate the relationship? Who will have the rights to use the technology? How are we going to make money out of it (e.g. with a product or with a service)? What are we going to give in return for the technology? How can we protect our competitive advantage?) .
-
- b. **Explain the links between Intelligence and Roadmapping and how these are practically useful in the development of strategic plans. [20%]**

Technology Strategy & Planning and intelligence



The question is based on the slide above and an exercise which was also picked up during the course case study. The question aims to elicit considerations about what the company needs to know to make plans and how the intelligence system (based on Technology, Market and Competitive intelligences) supply the relevant information which feed the specific layers of a roadmap. The practical use of the link is illustrated by the slide below (a specific case discussed in class) where the key questions needed to take decisions about new products and services require an understanding of aspects related to technology, market and competitors trends.

Basic answers will be limited to a generic explanation of the theoretical link. The more specific and embedded in practice the answer is, the clearer would be how the understanding of the link has been internalised.

What do we need to know?



Question 3 Crib

- a. Explain the concept of disruptive technologies and discuss why large, established firms find it difficult to respond to technologies which have the potential to become disruptive. [20%]**

This question aims to ascertain the understanding of

- *The concept of disruption and disruptive technologies*
- *The ability to explain why incumbent firms struggle*
- *[The capacity to integrate disruption with other course concepts (e.g. S-curves, uncertainty, decision-making) would make the answer more robust]*

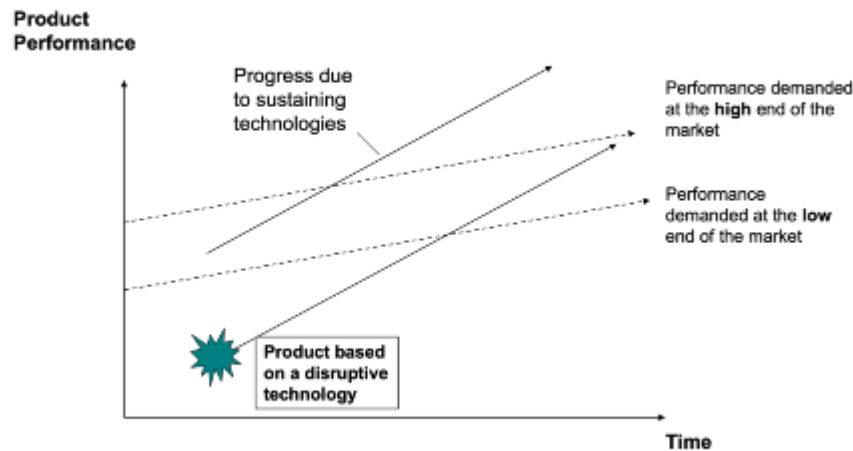
Basic answers will describe the concept of disruptive technologies based upon the very simple summary slide shown below.

- Clear explanation that disruptive technologies: Initially underperform on attributes valued by mainstream customers / Emerge in low-end or new markets/ Improve over time and eventually challenge incumbents. Showing distinction between Disruptive and sustaining technologies and recognition that disruption is not synonymous with radical or breakthrough technology
- For incumbent firms Identification of challenges such as difficulty assessing the future impact of early-stage technologies/ Technologies appearing unattractive relative to existing customers and metrics/ Organisational inertia due to scale, routines, and existing investments. Recognition that incumbents' responses are often rational, not incompetent

Stronger answers offer a deeper explanation of incumbent failure (incumbents may allocate resources based on current customers and margins, use existing performance metrics that disadvantage disruptive technologies, face internal competition for resources from sustaining innovations). These answers recognise that disruption often involves business model conflict, not just technology change.

Stronger answers may use of technology performance S-curves to explain why disruptive technologies appear inferior initially and why incumbents remain committed to the current dominant technology (Difficulty of investing in a new S-curve with uncertain returns since many new techs fail in the long term)

Sustaining & Disruptive Technologies



b. i. Describe the Business Model Canvas [15%]

This question aims for a fast recollection of the tool by Osterwalder. This helps the preparation of the application of the tool in the second part of the question.

Answers should at least comprise the basic structure and include the Business model canvas' purpose (to describe how an innovation/technology could be exploited in the market) and the logic along which it is designed.

Better answers will be complete (all the 9 elements of the BMC) also mention the potential and uses for such tool, including for instance the power to articulate the logic of a business model in a single view, explore alternative business models, compare competing or future business models, support experimentation, learning, and innovation

ii. Using the Business Model Canvas, describe the business model of the University of Cambridge. [30%]

In this question part the BMC structure is put to use.

Students should consider who are the customers. Basic answers would recognise at least one group (e.g. students) but better answers will acknowledge that there are different stakeholders who receive value from this university. (e.g. collaborating companies, government and ultimately society), recognising (even if not drafting) that, for each of these “customers”, a different Canvas could be drafted. The answers will be highlighting at least some of the elements in the canvas:.

In particular, the value proposition and the different resources, channels etc that support the delivery of this value and the value capture I.e. the different mechanisms for receiving money against value).

The completeness/richness of the answers would improve the quality.

c.

a. PhotonIQ Ltd is a university spin-out developing a novel optical sensing technology with potential applications in medical diagnostics and the monitoring of industrial systems. The founding team includes academic researchers who value publication and scientific recognition, alongside a newly appointed commercial director focused on building long-term industrial competitive advantage. Recent experimental results demonstrate strong technical performance for their optical sensing technology, and the team is preparing to publish information about their technology in a high-profile academic journal paper. At the same time, early discussions with potential investors have raised concerns about intellectual property protection and freedom to operate. PhotonIQ must decide between *publishing* and *patenting* as it develops its technology and business.

Discuss the two options and where you see the main challenges for the management team. [35%]

This question assesses the understanding of the publishing–patenting tension as a strategic issue, offering an opportunity to demonstrate an ability to build on the theoretical knowledge of IP management and consider managerial judgement in dealing with key strategic challenges.

Answers should recognise the fundamental sources of the tension: Publishing requires public disclosure and patenting requires novelty, which disclosure can destroy. Removing patentability could reduce future appropriability. Hence a sequence is necessary: patents should be filed first, before any publication is done.

So ,the challenge for the team is to identify a ‘sweet’ spot that might help the recognition of their scientific profile, without compromising the most important and future oriented (and patentable) opportunities for the firm. For this a very though

analysis which needs to be done in collaboration with professional advisers experienced in this sort of situations (patent landscaping).

The core challenge for the management team is not choosing one over the other, but integrating both into a coherent innovation strategy. Success will depend on:

- sequencing disclosure carefully,
- aligning academic and commercial incentives,
- developing a focused IP strategy,
- and balancing scientific openness with commercial protection.

PhotonIQ should likely pursue rapid provisional patent filing before disclosure, selective publication afterwards, and careful retention of certain tacit or process knowledge as trade secrets.

Publishing is important as, by publishing, the academic involved could gain scientific credibility, knowledge dissemination which are fundamental in a research-intensive context. This might signify more access to grants and funding to develop what might be likely to be an early stage technology (as this is an academic spin off).

One challenge with patents, as they have a high-cost. This narrows the options application field – this is a high-stake strategic choice. It may be especially difficult to know where to patent (and what claims to build the patent on) especially when the company is still uncertain about the final market opportunities (the technology seems to be generally applicable in many fields).

This allows the company to preserve patentability while still achieving academic and signalling benefits.

The management problem becomes one of boundary management:

- What should be disclosed?
- What should remain proprietary?
- Which applications should be patented first?
- Which knowledge is strategically better protected as tacit know-how?