

MET3
MANUFACTURING ENGINEERING TRIPOS PART IIB

Wednesday 27 April 2022 9 to 12.10

Paper 2

*Answer not more than **four** questions.*

Answer each question in a separate booklet.

All questions carry the same number of marks.

*The **approximate** number of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS

8 page answer booklet x 4

Rough work pad

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM

CUED approved calculator allowed

Engineering Data Book

10 minutes reading time is allowed for this paper at the start of the exam.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

You may not remove any stationery from the Examination Room.

1 The executives of an established multinational detergent company are reviewing their technology and business strategy to make sure the company is ready to face significant changes in the market in the next 5 years. They expect changes as consequences of updates of trade frameworks, changing consumer preferences related to anthropogenic climate change and the Covid-19 pandemic. The executives are interested in identifying and taking advantage of new technologies to face this emergent uncertain future.

(a) Describe what is meant by *technology roadmapping* and explain, using examples from the scenario described above, how the company could use it to support the development of its strategic plans. [20%]

(b) Describe four other *technology management tools* that the company could deploy and explain how these could be combined with technology roadmapping for its strategic planning. [40%]

(c) Discuss how the company could configure their *technology management processes* to support the development and implementation of the strategic plans. [40%]

- 2 (a) Describe and explain the uses of:
- (i) *Technology S-Curves*;
 - (ii) *Technology Readiness Levels (TRLs)*. [30%]
- (b) 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. [40%]
- (c) Discuss how *open innovation* could be used to help firms deal with technologies that have the potential to become disruptive. [30%]

3 (a) Discuss the differences between the typical people management challenges a leader would be expected to address within the following contexts:

- (i) a large, long-established multinational firm;
- (ii) a large but fast-growing technology firm;
- (iii) an early-stage technology firm backed by venture capital. [50%]

(b) Discuss the people-related issues that might need to be considered with the emergence and diffusion of industrial digitalisation technologies from the perspective of:

- (i) a national government;
- (ii) a large manufacturing firm. [50%]

- 4 (a) Define and explain the concept of *strategy* in the business environment. [15%]
- (b) Within the broad concept of *strategy*, explain what is meant by *operations strategy*. [15%]
- (c) Explain the concept of *strategic reconciliation* (also known as *strategic alignment*) in the context of *operations strategy* and *business strategy*. [20%]
- (d) Discuss the interaction between *business strategy* and *operations strategy* with a focus on:
- (i) *competitive priorities*;
 - (ii) *performance objectives*;
 - (iii) *strategy decision areas*. [25%]
- (e) Discuss why *strategic alignment* might be difficult to achieve in practice. Give two different case examples of *strategic alignment* (or lack thereof) from your recent experiences or studies. [25%]

5 (a) Explain the key principles, benefits and barriers of the *Circular Economy* model, discussing how the principles could be implemented in industry. Provide examples where appropriate. [30%]

(b) Electric cars are starting to dominate the mobility business in many economies. Tesla, Nissan and BMW are some of the leading innovators in this space.

(i) Using the technical cycle of the *MacArthur Foundation Circular Economy Approach*, explain and illustrate with examples the Circular Economy of electric cars. [40%]

(ii) Using the *value exploration* approach, explain and illustrate with examples the *value captured*, *value uncaptured* and *value opportunity* of electric cars. [30%]

6 Tetra Pak is the world's largest food packaging company with annual sales of €11.5 billion and around 25,000 employees operating out of 160 countries.

Tetra Pak was founded in Sweden in 1943. In 1954, the Company developed the first 500ml tetrahedron milk packaging machine. During the 50s and 60s they invested massively in research and development and, by the 70s, they had developed the most advanced equipment and packing material on the market, carefully protected by various patents. Their aseptic packaging technology has been called "*the most important food packaging technology of the 20th century*" by the Institute of Food Technologists. The Company adopted a business model of selling the machinery to customers linked with exclusive supply of the carton material. Tetra Pak material was only sold to Tetra Pak machinery customers and these customers were barred from using carton material from other suppliers. By 1985, Tetra Pak had 91.8% of the EU market in aseptic filling machines and 89.1% of the market in the relevant cartons. In 1986, Tetra Pak acquired the Lquipak Group who had developed and patented a different but comparable technology. The EU Commission became concerned that Tetra Pak was using anti-competitive trading techniques in contravention of EU regulations. Court action dragged on for many years, but in the late 1990s the court ruled against Tetra Pak which was fined for anti-competitive trading behaviour. In 2000, the Company started a complete review of its business strategy.

(a) Using the information above and stating any assumptions, use *Porter's Generic Competitive Strategies* tool (1985) or *Treacy and Wiersema's Value Disciplines* model (1995) and not more than 2 other marketing/business model tools to:

(i) Discuss Tetra Pak's business strategy up to 2000. [20%]

(ii) Outline and justify a strategy that Tetra Pak should adopt for the start of the 21st century. [30%]

(b) Following the legal case, Lars Andersson, the Group Operations Director for Tetra Pak, was considering reviewing the Company's operations. The *Overall Equipment Effectiveness (OEE)* of the two plants in Dijon and Wrexham was under discussion to establish whether and how to rationalise manufacturing. One of his trusted lieutenants made the following observation: "*The factory at Dijon has a 7-colour printer which runs at 85% OEE – that's World Class! The same printer in Wrexham has an OEE of only 56%. Why not shut Wrexham and move the machinery to Dijon where the expertise of the French printers will give you a higher output at much lower cost?*". The OEE models for the Dijon and Wrexham sites are shown in Table 1 and Table 2 respectively.

<u>Dijon</u>				
Reference Period	1 week			
OEE	85.6%			
Scheduled Time	120 hours = 100%			
Unaccounted OEE Losses	0.3 hours = 0.2% of Scheduled Time			
Loss Analysis				
	Number of events	Average event duration (min)	Total time (hours)	Percentage of Scheduled Time
Breakdowns	4	75.0	5.0	4.2
Short Stops	15	10.0	2.5	2.1
Speed Losses	1	90.0	1.5	1.3
Lack of Materials	2	45.0	1.5	1.3
Set-ups	3	120.0	6.0	5.0
Tool Change	0	0.0	0.0	0.0
Scrap	1	30.0	0.5	0.4

Table 1

<u>Wrexham</u>				
Reference Period	1 week			
OEE	55.8%			
Overall Scheduled Time	120 hours = 100%			
Unaccounted OEE Losses	0.8 hours = 0.7% of Scheduled Time			
Loss Analysis				
	Number of events	Average event duration (min)	Total time (hours)	Percentage of Scheduled Time
Breakdowns	4	30.0	2.0	1.7
Short Stops	10	7.2	1.2	1.0
Speed Losses	1	300.0	5.0	4.2
Lack of Materials	2	45.0	1.5	1.3
Set-ups	50	48.0	40	33.3
Tool Change	2	60.0	2.0	1.7
Scrap	1	30.0	0.5	0.4

Table 2

- (i) Assuming distribution costs are similar for either site, if the company is to shut a plant, should it be Wrexham? Justify your answer. [25%]
- (ii) Based on the analysis above, and stating any assumptions, discuss the options available to Lars Andersson with regards to the Dijon and Wrexham plants when considering the different operational strategies that are available to the Company. [25%]

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