

MET3
MANUFACTURING ENGINEERING TRIPOS PART IIB

Wednesday 28 April 2021 9 to 12.10

Paper 2

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

All questions carry the same number of marks.

*The **approximate** percentage 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

Write on single-sided paper.

You may type your answers.

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM

CUED approved calculator allowed.

You are allowed access to the electronic version of the Engineering Data Books.

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

The time taken for scanning/uploading answers is 30 minutes.

Your script is to be uploaded as a single consolidated pdf containing all answers.

1 You have been appointed as a technology manager for a multinational food and drink firm and have been asked to see what technologies could be used to reduce the environmental impact of the firm and its suppliers over the coming 5-10 years.

(a) Describe what activities you would recommend the firm uses to *identify* and *select* specific technologies that have the potential to be deployed to reduce your firm's environmental impact. [25%]

(b) The identification and selection activities reveal one specific technology that has the potential to have a significant impact on reducing energy consumption across your firm and its suppliers' manufacturing operations. Discuss the pros and cons of *acquiring*, *protecting* and *exploiting* this technology by:

- (i) Working in collaboration with a UK-based university research lab;
- (ii) Partnering with a fast-growing technology start-up based in Sweden;
- (iii) Developing the technology within your own company's R&D labs. [75%]

2 As the recently appointed Chief Technology Officer of MotorManufacturer a large, long-established UK-based car manufacturer, your aim is to develop the technology strategy which allows the firm to leverage emergent digital technologies and adapt to fast changing trends in the firm's environment. By applying technology and innovation management principles and tools, and by providing illustrative examples, discuss:

(a) The *trends* and *uncertainties* you expect will impact on the strategic plans of MotorManufacturer. [40%]

(b) How you would suggest that MotorManufacturer designs and implements activities to *identify* relevant technological trends. [60%]

3 ManuVR is a UK-based start-up firm whose core business is the provision of low-cost Virtual Reality (VR) systems to help manufacturing firms train their production line employees. ManuVR's business model is based around the design, implementation and support of VR solutions, and buys all its technology from suppliers in China and the US. The firm is five years old and has grown from 3 to 50 staff during that period. It has received Venture Capital (VC) funding and sales are now growing very fast, particularly in Europe. A large European industrial automation company (IndustrialAuto) is very interested in partnering with ManuVR. IndustrialAuto does not have expertise in VR, but recognises the increasing demand for VR systems from its current customers.

- (a) Discuss the typical people management issues ManuVR is likely to have faced during its first five years of operations. [30%]
- (b) From the perspective of ManuVR's management team, discuss the main people-related issues that they should be aware of as they set up and manage the partnership with IndustrialAuto. [30%]
- (c) For IndustrialAuto, the partnership with ManuVR represents two changes: working with new people, and working with a new technology. What advice would you give to the CEO of IndustrialAuto to ensure that these changes are managed successfully? [40%]

- 4 (a) The literature indicates that there are several different schools of strategy.
- (i) Compare and contrast how the *Market-Based* approach to strategy championed by Porter, and the *Resource / Capability-Based* approach championed by Penrose can be used to develop a sustainable competitive advantage. Discuss with examples why companies might prefer to adopt one approach over the other. [40%]
- (ii) Explain how the two approaches named above could be combined to achieve *Strategic Alignment* (i.e. Strategic Fit and Strategic Reconciliation). [20%]
- (b) Identify three aspects of their business where companies are experiencing problems as a result of the Covid-19 pandemic. Discuss and give examples of what actions they might consider implementing to recover and develop a new sustainable competitive advantage. [40%]

5 CCI, a small manufacturing firm, makes a single product through a plastic extrusion process: disposable coffee capsules. These are manufactured from a single material, in two parts: a lid and a cup. Plastic waste from CCI includes rejected products from the quality check, as well as various losses of raw material and finished products. About 1% of both lids and cups are rejected for being of incorrect dimension. Single units made of one lid and one cup are sold on to a downstream customer, DDH. DDH fills the cups with coffee, puts on the lids, and wraps each filled capsule in aluminium foil. These are then sold to retailers and then to consumers. At end-of-life, capsules are landfilled, as the contamination with the coffee grounds makes recycling difficult. Key statistics for CCI in 2020 are summarised in Table 1. Stocks of material and finished product at the beginning of the year 2020 can be assumed to be negligible.

Total Food-Grade Plastic Purchased	255,000	kg
End of Year Food-Grade Plastic Stock	45,000	kg
Design Mass (Lid)	2.35	g
Design Mass (Cup)	4.20	g
Total Production (Lids)	33,772,662	Lids
Total Production (Cups)	27,607,599	Cups
Rejection rate (Quality)	1.00	%
Sales (1 Capsule = 1 lid + 1 cup)	25,604,000	Capsules
End of Year Product Stock	1,950,000	Capsules

Table 1

- (a) (i) *Zero Loss Yield* has been proposed as a suitable metric to analyse the material efficiency of the CCI process. Why is this an appropriate approach? Comment on how one would go about gathering the appropriate data in a real-world example. [15%]
- (ii) Identify and comment on the main sources of potential material loss for CCI, stating any assumptions you make. [40%]
- (b) Using the concept of *Value Uncaptured*, discuss the pros and cons of the three following options for sustainability improvement, and the implications they have for the sustainability of the whole *cradle-to-grave process cycle*:
- (i) The mass of plastic in the cups produced can be reduced by 25% by redesigning the product. This will require new moulds for the injection moulding line. [15%]
- (ii) Current materials (the aluminium foil and the plastic capsule) can be replaced with biodegradable alternatives to allow the product to be composted after use. [15%]

- (iii) A 'Just-in-Time' production process will ensure that no stock of raw material is held on site at any time. [15%]

6 You are the Chief Operating Officer of a large multinational firm that manufactures construction and mining equipment. Your firm's strategy focuses on delivering industry-leading products and services to customers to achieve profitable growth for the shareholders. Considering the firm's strategy and by applying performance measurement principles, frameworks and tools:

- (a) Discuss and illustrate with examples five operations performance objectives for your manufacturing firm. [30%]
- (b) Discuss and illustrate with examples the purposes of the implementation of performance measures in your manufacturing firm. [30%]
- (c) Explain and illustrate with examples the *balanced scorecard* for your manufacturing firm. [40%]

END OF PAPER