



EXAMINATION SOLUTIONS

(to accompany the examination paper sent to the external examiner
but NOT to be seen by students)

Programme:	BEng Mechanical and Manufacturing Engineering; BEng Extreme Sports Engineering; BEng M/Sport. M/Cycle, Auto Engineering	Level:	5
Module:	Management Innovation & Sustainability		
Authors:	Andrew Thorn & Mark Sandford	Page:	

Q 1	Question	Marks																																										
a)	Candidates are required to calculate payback for each project in years and months. Project Supernatant <table><tr><th>Year</th><th>Net cash flow</th><th>Cumulative Cash Flow</th></tr><tr><td>0</td><td>(£200,000)</td><td>(£200,000)</td></tr><tr><td>1</td><td>£20,000</td><td>(£180,000)</td></tr><tr><td>2</td><td>£40,000</td><td>(£140,000)</td></tr><tr><td>3</td><td>£60,000</td><td>(£80,000)</td></tr><tr><td>4</td><td>£60,000</td><td>(£20,000)</td></tr><tr><td>5</td><td>£60,000</td><td>£40,000</td></tr></table> Payback = 4 years and X months Calculation of month = Income required / contribution per month Contribution per month = £60,000 / 12 = £5,000 Calculation of month of payback = £20,000 / £5,000 = 4 months Project Supernatant payback = 4 years and 4 months Project Fuge 41 <table><tr><th>Year</th><th>Net cash flow</th><th>Cumulative cash flow</th></tr><tr><td>0</td><td>(£200,000)</td><td>(£200,000)</td></tr><tr><td>1</td><td>£80,000</td><td>(£120,000)</td></tr><tr><td>2</td><td>£60,000</td><td>(£60,000)</td></tr><tr><td>3</td><td>£60,000</td><td>0</td></tr><tr><td>4</td><td>£40,000</td><td>£40,000</td></tr><tr><td>5</td><td>£40,000</td><td>£80,000</td></tr></table> Pay back = 3 years exactly As this project pays back in exactly 3 years there is no need to calculate the month of payback.	Year	Net cash flow	Cumulative Cash Flow	0	(£200,000)	(£200,000)	1	£20,000	(£180,000)	2	£40,000	(£140,000)	3	£60,000	(£80,000)	4	£60,000	(£20,000)	5	£60,000	£40,000	Year	Net cash flow	Cumulative cash flow	0	(£200,000)	(£200,000)	1	£80,000	(£120,000)	2	£60,000	(£60,000)	3	£60,000	0	4	£40,000	£40,000	5	£40,000	£80,000	
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Project Centre 4

Year	Net cash flow	Cumulative cash flow
0	(£200,000)	(£200,000)
1	£60,000	(£140,000)
2	£60,000	(£80,000)
3	£60,000	(£20,000)
4	£60,000	£40,000
5	£60,000	£100,000

Payback = 3 years and X months

Calculation of month = Income required / contribution per month

Contribution per month = £60,000 / 12 = £5,000

Calculation of month of payback = £40,000 / £5,000 = 8 months

Project Centre 4 Payback = 3 years and 8 months

- b) Candidates need to calculate the Net Present Value (NPV) for each project

Project Supernatant

Year	Cash flow (£)	Discount Factor	Present Value
0	(200,000)	1.00	(£200,000)
1	20,000	0.9091	£18,182
2	40,000	0.8264	£33,056
3	60,000	0.7513	£45,078
4	60,000	0.6830	£40,980
5	60,000	0.6210	£37,260

Total cash flow = £174,556

Net Present Value = Total cash flow – Initial Investment

= £174,556 - £200,000

= (£25,444)

Project Fuge 41

Year	Cash flow (£)	Discount factor	Present Value
0	(200,000)	1.00	(£200,000)
1	80,000	0.9091	£72,728
2	60,000	0.8264	£49,584
3	60,000	0.7513	£45,078
4	40,000	0.6830	£27,320
5	40,000	0.6210	£24,840

Total cash flow = £219,550

Net Present Value = Total cash flow – Initial Investment

= £219,550 - £200,000

= £19,550

**8
marks**



Project Centre 4

Year	Cash flow (£)	Discount factor	Present Value
0	(200,000)	1.00	(£200,000)
1	60,000	0.9091	£54,546
2	60,000	0.8264	£49,584
3	60,000	0.7513	£45,078
4	60,000	0.6830	£40,980
5	60,000	0.6210	£37,260

Total cash flow = £227,448

Net Present Value = Total cash flow – Initial Investment
 = £227,448 - £200,000
 = £27,448

**8
marks**

- c) Candidates are required to evaluate which project is the best option for the company.

In terms of payback Project Fuge gives the quickest return on the initial investment paying back in three however, Project Centre 4 gives a better return on capital over time and pays back in 3 years 8 months.

Candidates can select either Project Centre 4 or Project Fuge as the best option, but they must justify their choice.

**4
marks**

- d) Candidates are required to evaluate two factors that should be considered as part of the decision-making process. These factors include: -

- **Motives for investment**: - include change in technology, need to grow the business, pressure from competitors and to comply with legislation.
- **External factors**: - includes exchange rates, interest rates, level of inflation and trend (rising/falling), government policies and world market situations.
- **Business confidence**: - include past success of investment, market share, state of the economy, existing capacity levels versus predicted future capacity, current order levels, and profits.

**5
marks**

Q 2	Question	Marks
a)	Candidates need to explain what factors can lead an organisation to make changes to the way it operates. These include: - • Resource efficiency and effectiveness (making better use of existing resources) • Product and service ageing and obsolescence, products coming to the end of their life and parts no longer manufactured • Staffing levels, expertise and mix ensuring the business has appropriate numbers of employees that enable it to operate. Relevant level of	



	competencies • Reduced and eroded profit margins • Increase in costs of raw materials, utilities and labour • Need to manage • Technological change • Competition changing their offerings providing new services • Customer demands- customer requirements change over time • Shareholders requiring a company to be ethical and adopt environmental policies Credit will be given for relevant answers.	8 marks
b)	Candidates need to discuss the reasons why change often fails using examples to support answers. Up to (4 marks) are available for the use of appropriate examples. Suitable answers include: - • Resistance to change may be active or passive, overt or covert, individual or organised, aggressive or timid and on occasions to totally justified • Sadly most significant change fails to meet the expectations and targets of the proposers • The failure is given the name resistance, yet resistance can be principled and creative as well as from vested interest • Top management is frequently unreasonable in its expectations and timescales, forgetting the process it went through when it decided to make the change • Allowing too much complacency and making assumptions that people will willingly follow what is proposed • Failure to generate sufficient resources to see the proposed changes through • Failure to communicate effectively and continuously with everyone involved • Lack of honesty and integrity especially when further changes are required • Becoming side-tracked into operational problems and issues • Failure to create or publicise short term advantages, wins and successes • Failure to reward people for their efforts • Failure to deliver to people those rewards which were promised or strongly indicated Credit will be given for relevant answers.	9 marks
c)	Candidates need to analyse what steps can be taken to turn resistance into support. Suitable answers will address the following: - 1. Level 1 Make your case. • Make sure people know why a change is needed • Present the change using language they understand • Find multiple ways to make your case. People take information in different ways 2. Level 2 Remove as much of the fear as you can • Emphasise what is in it for them • People need to believe that the change will serve them in some way	



	• Get them engaged in the process. People tend to support things they have a hand in building • Be honest. If a change will hurt them- then tell the truth 3. Level 3 Rebuild damaged relationships • Take responsibility for things that may have led to the current tense relations • Keep commitments. Demonstrate that you are trustworthy • Find ways to spend time together so they get to know you (and your team) • Allow yourself to be influenced by the people who resist you. Credit will be given for relevant answers.	8 marks												
Q 3	Question	Marks												
a)	Candidates are required to calculate the full cost of making the pressure vessels. Firstly, candidates need to calculate the overhead costs (indirect costs) per hour. Overhead costs are as follows: - <table><tr><td>Indirect labour costs</td><td>£36,000</td></tr><tr><td>Depreciation of equipment</td><td>£14,000</td></tr><tr><td>Rent and rates</td><td>£10,000</td></tr><tr><td>Heating and electricity</td><td>£8,000</td></tr><tr><td>Indirect materials</td><td>£1,800</td></tr><tr><td>Total</td><td>£69,800</td></tr></table> Now calculate the overhead cost per hour. Total overhead costs / Direct labour hours = £69,800 / 12,000 = £5.82 Total overhead costs per vessel are: - 30 hours x £5.82 = £174.60 Now calculate direct labour costs. Each vessel requires 30 hours direct labour. Direct labour cost per vessel = 30 x (£180,000 / 12,000) = £450 Materials costs per vessel £800. Now calculate the total cost of each element (materials, labour and overheads) Materials costs = 8 x £800 = £6,400 Labour costs = 8 x £450 = £3,600 Overhead costs = 8 x £174.60 = £1396.80 Total cost of the job is £11,396.80	Indirect labour costs	£36,000	Depreciation of equipment	£14,000	Rent and rates	£10,000	Heating and electricity	£8,000	Indirect materials	£1,800	Total	£69,800	3 marks 2 marks 2 marks 1 mark 3 marks 1 mark
Indirect labour costs	£36,000													
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b)	Candidates are expected to calculate the price the company should quote for the job based on a 30% profit.													



	30% profit = Full cost of job x % profit 30% profit = £11,396.80 x 0.3 30% profit = £3,419.04 Price quoted = Full cost + profit = £11,396.80 + £3,419.04 = £14,815.84 c) Candidates need to explain what is meant by the term profit centre along with their advantages and disadvantages. A profit centre is part of the business where costs and revenues can be clearly defined. They allow managers to identify the profitability of different parts of the organisation. Advantages of profit centres are: - • The performance of specific operations can be monitored • Staff and managers in each profit centre might be better motivated knowing that their own centre is independently accountable • Loss making operations can be clearly identified and action taken Disadvantages of profit centres are: - • Parts of the business can put themselves before the business as a whole • The reason for good or bad performances may be external to the cost centre, and not under its control • Not all costs and revenues can be associated directly with a particular part of the firm Credit will be given for relevant points.	2 marks 2 marks 9 marks
Q 4	Question	Marks
	Candidates are required to produce a report that explains the new product development process in detail. The process consists of the following stages: - 1. Idea generation 2. Idea screening 3. Concept development and testing 4. Marketing strategy 5. Business analysis 6. Product development 7. Market testing 8. Product launch Idea generation: - An idea for a new product or service can come from a variety of sources, both internal and external to the company, and can be driven by market or technological forces. Internally, new ideas may flow from the sales force and service engineers who are close to customer needs, production and R & D specialists who are close to new technological developments, and top management who know the company's strengths and weaknesses. Externally, ideas may come from customers, competitors, or channel members like industrial distributors.	



Idea screening: - Comprises the activities of selecting the new product ideas that will be forwarded to the following phases of NPD process. During this stage, new product ideas through a screening process by considering whether they can satisfy their strategic goals with the available corporate resources and knowhow.

Concept development and testing: - After the concept is developed, a concept test follows which ensures that the product under development is what the target market needs. During concept testing information is collected about:

- The degree to which the customers perceive the appropriateness of the new product idea for satisfying their needs
- Their intention to buy or try the new product

This information reflects the reactions of potential customers and it can be either used to permit the developer to estimate the sales value of the concept or to make changes to the concept to enhance its potential sales value.

Marketing strategy: - Consists of analysis of external environment and internal environment, marketing objectives, marketing strategy and action plan.

The marketing strategy will address description of new product reference to the marketing plan's time frame, the marketing plan's relation to other corporate plans, obligations and responsibilities of company's executives.

Analysis of external environment: -

- Size of the market
- Market growth rate
- Customer analysis
- Competitor analysis
- Description of market trends
- Opportunities and threats of the external environment

Analysis of internal environment: -

- Marketing audit (description of marketing activities and outcomes)
- Strength and weakness of the company

Marketing objectives

- Quantitative (sales and profits)
- Qualitative (opinions and image)

Marketing strategy

- Target market
- Product strategy
- Pricing strategy
- Distribution strategy
- Promotion strategy

Action plan

- Pricing activities
- Distribution activities
- Promotion activities
- Action plan monitoring mechanism
- Budget
- Time schedule and assignment of responsibilities

Business analysis: - Stage in which the new product idea is more thoroughly evaluated taking into consideration the respective financial facts. A cost-benefit analysis is conducted where the expected sales and profits are estimated and compared to the cost of developing and nurturing the new product. Business analysis is based on a number of projections regarding: -



	• The life of the new product and market demand over the product's life cycle • The development, production and launching costs • The investments needed in assets, equipment, working capital and market development • The selling price • The sales revenue, profitability and return on investment Product development: - Absorbs the largest part of the budget and is often the longest in the whole process. A product prototype is usually developed and is operationally tested as a way to examine the technical feasibility of a new product. It also involves bringing two separate elements into accord: customer satisfaction and technical feasibility. Agreement must be reached on: - • The definition of the target market • The product's concept • The benefits the product will deliver • How the product will be positioned in the market • The product's features, attributes, design specifications and requirements Market testing: - Can be viewed as an acceptable test, which when feasible, can provide useful information as it involves: first, the identification of key purchasing influences; secondly, the testing of user reaction to the product and its features; thirdly, the testing of price possibilities and an assessment of users' reaction to various price levels; fourthly, the determination of the most effective sales approach; and lastly, the testing of the effectiveness of promotional materials and plans. Product launch: - costs increase dramatically as considerable investments are made in production facilities, training and the launch prepares the market for the launch such as pre-announcement information. Secondly, during the launch the targeting of marketing actions to the most appropriate group of potential customers needs to be considered. Next, decisions must be made regarding product positioning and the final step of the launch process is to develop and implement tactics aimed at attacking the market. Candidates are expected to capture and explain the essence of each stage. Better marks will be awarded for more detailed answers.	25 marks
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Q5	Question	Marks
5 a	a) The student should outline 3 types of sponsorship from the list below : ☐ Programme sponsorship - TV, films, product placement ☐ Arts sponsorship - Venues, events/exhibitions, competitions, commissions, ☐ Sports sponsorship - Teams ☐ Sponsorship of events - Single, series ☐ Sponsorship of individuals - David Beckham, Michael Jackson ☐ Social sponsorship - Promoting ethical credentials	7 marks



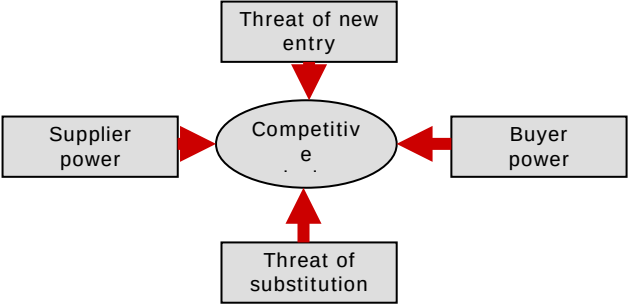
5 b	b) The student should outline some potential benefits, these include: Increased awareness of products and services Build an image Improve or maintain relationships Increase sales and open closed markets Attract distributors or agents Promotional opportunities Cost effective for reaching a large audience	7 marks
5 c	a) The student should use the S.O.S.T.A.C. model and discuss the steps S - situation analysis (where are we now) How much money have we got, what can we offer .O - objectives (where do we want to go?) How much money do we need to run the team Who can we target .S - strategy (how do we get there?) Develop sponsorship plan, costings/benefits Size of target audience, TV/press coverage etc .T - tactics (the details of the strategy) Review potential sponsors and their history Contacting routes, direct or through agency .A - action (putting the plans to work) Approaches, explaining potential benefits .C - control (monitoring and review) Success of gaining sponsorship Working with the sponsor to monitor the impact of the sponsorship Extra marks will be awarded when problems of sponsorship esp unpredictability are identified and discussed with potential organisations.	11 marks

Q6	Question	Marks
	An existing racecar manufacturer specialising in club racing and sports 2000 (MCR) have recently developed a new product, a turbocharged 2 litre sports car . . The vehicle is designed to be a road going race/sports prototype performance vehicle suitable for the trackday market..	
6 a	Explain the possible range of types of contract that MCR could employ with its range of suppliers of components and engineering services. Use a graphic model as appropriate Students should apply the triangle model covering extremes of cost plus profit and fixed price.	



	Fixed price Fixed price with escalation Fixed price with incentives Fixed costs Cost reimbursement Costs fee plus costs plus Characteristics of the different contract types	7 marks
	MCR is to place contracts with tier 1 suppliers for the design, development and supply of various components. For the following components evaluate the most appropriate contract type, explain your justification and outline the contract terms you would think appropriate.	
6 b	The design and development of a steel tube chassis and suspension system Students should discuss; It's a significant part of the vehicle in terms of cost and performance Exclusive design and development for them Probably cost plus with incentives Contract should include an NDA and cover any possible IPR ownership Production cost targets would be important.	7 marks
6 c	Ford duratec 2 litre engine supplied with turbo charger from an external tuning company. Ford engine cheap and available Supercharging is special. MCR need to keep costs down, nothing fancy, limited volume Probably fixed price with penalties for reliability Possible contract for post season rebuild contracts, incentive.	7 marks
6 d	Complete brake system, from master cylinder to the discs Simple fixed price contract Materials can be road car based eg steel rotors. Supplier could provide development free or 'at cost' due to the potential ongoing business supplying replacement parts. Reliability is important.	4 marks



Q7	Question	Marks
	Riversimple from Llandridod Wells have recently launched a hydrogen fuel cell powered vehicle. The vehicle is small and light.. Riversimple currently lease vehicles to a variety of users, both private and commercial. Interest is currently strong, especially to green minded individuals, local government and fleet operators. The management at River Simple wish to analyse their current and potential future market position. There are currently limited places where compressed hydrogen is available.	
7 a	Describe the Porters Five Forces – Analysis of competitive position. The student should describe the generic five forces model 	5 marks
7 b	Apply the model to the Riversimple vehicle. The student should apply the model to the riversimple vehicle, listing such issues as : Supplier Power: Here you assess how easy it is for suppliers to drive up prices. This is driven by the number of suppliers of each key input, the uniqueness of their product or service, their strength and control over you, the cost of switching from one to another, and so on. The fewer the supplier choices you have, and the more you need suppliers' help, the more powerful your suppliers are. Esp Energy storage, fuel cell converter, hydrogen storage, bespoke electronics, body panels, glass etc Buyer Power: Here you ask yourself how easy it is for buyers to drive prices down. Again, this is driven by the number of buyers, the importance of each individual buyer to your business, the cost to them of switching from your products and services to those of someone else, and so on. If you deal with few, powerful buyers, they are often able to dictate terms to you. Esp fleet purchase power, desire of purchasers for green technologies, effect of legislation to purchase decision. Competitive Rivalry What is important here is the number and capability of your competitors – if you have many competitors, and they offer equally attractive products and services, then you'll most likely have little power	



	in the situation. If suppliers and buyers don't get a good deal from you, they'll go elsewhere. On the other hand, if no-one else can do what you do, then you can often have tremendous strength. Esp are there any competitors ? Threat of Substitution This is affected by the ability of your customers to find a different way of doing what you do – for example, if you supply a unique software product that automates an important process, people may substitute by doing the process manually or by outsourcing it. If substitution is easy and substitution is viable, then this weakens your power. Esp Alternative green vehicles, hybrids, small petrol/ethanol/bio diesel vehicles, electric vehicle eg offerings from Renault etc. Threat of New Entry Power is also affected by the ability of people to enter your market. If it costs little in time or money to enter your market and compete effectively, if there are few economies of scale in place, or if you have little protection for your key technologies, then new competitors can quickly enter your market and weaken your position. If you have strong and durable barriers to entry, then you can preserve a favourable position and take fair advantage of it. Esp electric versions of current carbon fuel products from eg PSA, GM Renault etc could choose to undercut price, reduced cost due to large volume tooling, dealer networks etc. More quadracycle 'tizzy' type vehicles	10 marks
7 c	Select four issues effecting the competitive position and suggest and describe possible changes that could improve the competitive position of the Riversimple vehicle. a) The student should recommend some strategies to improve the competitive position by either enhancing the product or limiting potential threats. Examples include: Supplier power Multi-source components eg energy storage, pursue other fuel cell technology Multi source glass and panels, or own the bespoke tooling Encourage providers to support more refuelling stations Buyer power Set up fleet sales and support structure Lobby authorities to maintain or extend tax and congestion charging benefits for zero emission vehicles.. Competitive rivalry Review journals and published info on potential competitors Secure any IP generated	



	Threat of substitution Lobby authorities to maintain or extend tax and congestion charging benefits. Enhance any unique selling points. Encourage urban transport authorities to set up zero emission zones. Threat of new entry Be scared, attempt to link up with a large vehicle manufacturer to offer dealer network support. Establish service contracts with fleet buyers.	10 marks
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