Strategic Professional – Options

Advanced Performance Management (APM)

Specimen Exam applicable from September 2019

APM ACCA

Time allowed: 3 hours 15 minutes

This question paper is divided into two sections:

Section A – This ONE question is compulsory and MUST be attempted

Section B – BOTH questions are compulsory and MUST be attempted

Present Value and Annuity Tables are on pages 8 and 9.

Do NOT open this question paper until instructed by the supervisor.

This question paper must not be removed from the examination hall.

APM

Think Ahead

ACCA

The Association of Chartered Certified Accountants

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The question paper begins on page 3.

Section A – This ONE question is compulsory and MUST be attempted

1 Company information

Iron Chicken (IC) is a multinational business which manufactures commercial building control systems. Building control systems include heating and air-conditioning systems, lighting controls, power and water monitoring and security systems (e.g. keypad access, alarms and CCTV). IC's manufacturing takes place at a number of factory sites where some products have a long product life and are simple and mass-produced while other products are complex and have a short product life due to changing technologies.

IC's mission statement is 'to create value for shareholders through control products which improve productivity, save energy and increase comfort and safety'.

A new chief executive officer (CEO) has been appointed to address a decline in IC's share price in the last three years. This CEO has identified that the business has grown through acquisition and as a result she stated, 'senior management have focused on making corporate deals and not making control systems.' The CEO has declared that the business must focus on optimising its value generation rather than just getting larger through acquisitions. She has developed an improvement programme for IC.

You are a performance management expert within IC and the CEO has tasked you with aiding her on the four aspects of her improvement programme:

Economic value added (EVA™)

The CEO wants your views on the use of EVA™ as the key performance metric at IC. You have been supplied with the current EVA™ calculation (Appendix 1) but there is some doubt about whether the junior management accountant who has done this work was sufficiently trained in the method.

Therefore, the CEO requires you to evaluate its accuracy and the assumptions which form part of the calculation and advise her on your results, providing calculations as needed.

Critical success factors (CSFs) and key performance indicators (KPIs)

The CEO believes that the poor performance of the company can be addressed by ensuring that the mission statement flows down into the performance management of the business. To that end, the following critical success factors (CSFs) and the associated current key performance indicators (KPIs) have been identified:

	CSF	Associated current KPI
–	Greater staff productivity	Units produced per labour hour
–	Reduction of wastage in production	Power consumed per unit produced
–	Greater innovation of products	Number of new products launched

The CEO wants you to briefly explain a weakness of the current KPI associated with each CSF and then provide a justified alternative KPI.

Improvement projects

In order to improve performance, the CEO plans to implement initiatives associated with 'lean' manufacturing. Specifically, there are three projects which have been suggested and the CEO needs your advice on these:

1. Move to just-in-time manufacturing
2. Use kaizen costing
3. Examine the costs of quality in achieving a 'zero defects' approach to manufacturing

The CEO has stated that she needs you to explain what the three improvement projects are, how they will help to meet the CSFs at IC and also how they will impact on the existing three KPIs.

New information system

The CEO is concerned about the implications of the improvement projects for IC's information systems as she feels that they are not currently suitable for the plan that she has. The current information systems of the company are based around the functional departments of the business such as manufacturing, marketing, finance and logistics. Each department has developed its own system although all feed into the finance system which is the main one used for strategic decision-making. In order that the department systems can all feed through to the current finance system, these current systems only handle quantitative data. The company is considering the implementation of a new information system. This new system will introduce networking technology in order to bring together all of the departmental systems into a new, single, corporate database. The CEO would like an assessment of the impact of this proposed new information system on the three improvement projects.

It is now 1 September 20X5.

Required:

Write a report to the CEO of Iron Chicken to respond to her instructions for work on the following areas:

(i) the use of economic value added (EVA™) as the key performance metric at IC; (15 marks)

(ii) the current key performance indicators (KPIs) used by the company; (6 marks)

(iii) the three improvement projects; (15 marks)

(iv) the impact of the proposed new information system on the three improvement projects. (10 marks)

Professional marks will be awarded for the format, style and structure of the discussion of your answer. (4 marks)

(50 marks)

Appendix 1

Economic value added	Year ended 30 June 20X5	
	$m	Note
Operating profit	551·4	
Add back		
Non-cash expenses	15·1	
Marketing capitalised	23·1	5
Less		
Tax	134·8	6
Lost tax relief on interest	24·5	7
Net operating profit after tax (NOPAT)	430·3	
Capital employed		
From the statement of financial position	2,401·0	9
Marketing spend capitalised	23·1	5
Adjusted capital employed	2,424·1	

WACC = (1/2 x 16%) + (1/2 x 6·8%) = 11·4%

EVA™ = NOPAT – (WACC x Capital employed) = 154

Assumptions and notes:

1	Debt/Equity	100·0%
2	Cost of equity	16·0%
3	Tax rate	30·0%
4	Cost of debt (pre-tax)	6·8%

5 There has been $23·1m of marketing spent each year for the last two years in order to build the brand of IC long term.

6 Tax paid in the year was $130m while the tax charged per the accounts was $134·8m.

7 Interest charged in the period was $81·6m.
Lost tax relief on this interest was 30% x $81·6m.

8 The only research and development spending identified in the last five years was $10m expensed during this year on a new product.
The product has not been launched yet.

9 Capital employed during the period (from the statement of financial position):

Opening	2,282·0
Change in period	119·0
Closing	2,401·0

[P.T.O.

Section B – BOTH questions are compulsory and MUST be attempted

2 Company information

Culam Mining (Culam) is a mineral ore mining business in the country of Teeland. It owns and operates four mines. A mine takes on average two years to develop before it can produce ore and the revenue from the mine is split (25:75) between selling the ore under fixed price contracts over five years and selling on the spot market. The bulk of the business's production is exported. A mine has an average working life of about 20 years before all the profitable ore is extracted. It then takes a year to decommission the site and return the land to a useable form for agriculture or other developments.

Recent events

One of Culam's foreign competitors surprised the market by becoming insolvent as a result of paying too much to acquire a competitor when the selling price of their minerals dipped as the world economy went into recession. As a result, the chief executive officer (CEO) wanted to know if this was likely to happen to Culam. She had read about the Altman Z-score as a way of predicting corporate failure and had a business analyst prepare a report calculating the Z-score for Culam. The report is summarised in Appendix 1.

The analyst had done what was asked and calculated the score but had not explained what it meant or what action should be taken as a result. Therefore, the CEO has turned to you to help her to make sense of this work and for advice about how to use the information and how Culam should proceed into the future.

Required:

(a) Evaluate both the result of the analyst's calculations and the appropriateness of these two models for Culam. (10 marks)

(b) Explain the potential effects of a mine's lifecycle on Culam's Z-score and the company's probability of failure.

Note: You should ignore its effect on the Q-score. (7 marks)

(c) Give four detailed recommendations to reduce the probability of failure of Culam, providing suitable justifications for your advice. (8 marks)

(25 marks)

Appendix 1

Analyst's Report (extract)

The Altman Z-score model is:

$Z = 1{\cdot}2X1 + 1{\cdot}4X2 + 3{\cdot}3X3 + 0{\cdot}6X4 + X5$

Another quantitative model (Q-score model) has been produced by academics working at Teeland's main university based on recent data from listed companies on the small Teeland stock exchange. It is:

$Q = 1{\cdot}4X1 + 3{\cdot}3X3 + 0{\cdot}5X4 + 1{\cdot}1X5 + 1{\cdot}7X6$

Where for both models:

X1 is working capital/total assets;
X2 is retained earnings reserve/total assets;
X3 is profit before interest and tax/total assets;
X4 is market value of equity/total long-term debt (MVe/total long-term debt);
X5 is revenue/total assets;
and
X6 is current assets/current liabilities.

Using the most recent figures from Culam's financial statements (year ending September 20X4), Culam's Altman Z-score is 3·5 and its score from the other model (Q) is 3·1.

For both models, a score of more than 3 (for Z or Q) is considered safe and at below 1·8, the company is at risk of failure in the next two years.

3 Company information

Stokeness Engineering's (Stokeness) mission is to provide world-leading, reduced-emission, fuel-efficient products for the motor industry in order to optimise shareholder returns.

Stokeness has existed for only five years and is owned by its management and venture capitalists (VCs). The management were all engineers who had been working on the basic research associated with new fuel technologies and saw the opportunity to commercialise their expertise. Stokeness is highly regarded in the industry for its advanced, efficient fuel cell designs. As a result, the VCs were eager to invest in Stokeness and have assisted by placing experienced managers into the business to aid the original engineering team.

New product development

Stokeness is developing hydrogen fuel cells for use in powering large motor vehicles such as buses and trucks. They will replace standard petrol/diesel engines. The fuel cells have a clear advantage over these older technologies in having lower carbon dioxide (a greenhouse gas) emissions. The governments of many developed countries are keen to see cuts in such emissions and are supportive of a variety of possible technological solutions to this issue (such as fuel cells, electrical batteries and compressed natural gas).

External business environment

It takes five to ten years to develop a viable product for sale in this motor market. There are a number of companies developing fuel cells but Stokeness is believed to have a two-year lead over them and to be only three years away from commercial launch.

Alternative power technologies like the hydrogen fuel cells would be fitted by the major international vehicle manufacturers into their vehicles for sale to their customers. The vehicle manufacturers will need to form a close partnership with any engine producer in order to make their technologies compatible and this has already begun to happen, with two of the major manufacturers signing deals with other engine makers recently.

A major problem which needs to be overcome with any of these new technologies is that there must be an infrastructure accessible to the end users for refuelling their vehicles (as the petrol station chains do for petrol engine vehicles at present).

Governments have indicated their desire to support the development of such technologies to address environmental issues and to try to establish new, high-value industries in their jurisdiction. They may do this through tax breaks and investment to support the development of the refuelling infrastructure.

Production of Stokeness' fuel cells uses a special membrane which requires rare and expensive elements. Also, it has partnered with two other engineering firms to subcontract the production of certain components in the fuel cell. Stokeness has had to share much of its fuel cell design with these firms in order to overcome certain engineering difficulties.

Also, there are a number of start-up companies developing the other technologies mentioned previously, as well as large, existing diesel and petrol engine manufacturers who are constantly reducing the emissions from their existing engines.

The VCs have stressed the need to analyse competition and competitive advantage in order to understand how to make the business profitable in the long term. The chief executive officer (CEO) of Stokeness wants to understand the external business environment and its effect on performance management.

Required:

(a) Using Porter's five forces model, assess the impact of the external business environment on the performance management of Stokeness and give a justified recommendation of one new performance measure for each of the five force areas at Stokeness. (16 marks)

(b) Discuss how the problems of defining the market in measuring a market share apply for Stokeness. (4 marks)

(c) Assess the risk appetite of the venture capitalists and discuss how this might impact on performance measurement at Stokeness. (5 marks)

(25 marks)

Present Value Table

Present value of 1 i.e. $(1 + r)^{-n}$

Where r = discount rate
n = number of periods until payment

Discount rate (r)

Periods (n)	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	
1	0·990	0·980	0·971	0·962	0·952	0·943	0·935	0·926	0·917	0·909	1
2	0·980	0·961	0·943	0·925	0·907	0·890	0·873	0·857	0·842	0·826	2
3	0·971	0·942	0·915	0·889	0·864	0·840	0·816	0·794	0·772	0·751	3
4	0·961	0·924	0·888	0·855	0·823	0·792	0·763	0·735	0·708	0·683	4
5	0·951	0·906	0·863	0·822	0·784	0·747	0·713	0·681	0·650	0·621	5
6	0·942	0·888	0·837	0·790	0·746	0·705	0·666	0·630	0·596	0·564	6
7	0·933	0·871	0·813	0·760	0·711	0·665	0·623	0·583	0·547	0·513	7
8	0·923	0·853	0·789	0·731	0·677	0·627	0·582	0·540	0·502	0·467	8
9	0·914	0·837	0·766	0·703	0·645	0·592	0·544	0·500	0·460	0·424	9
10	0·905	0·820	0·744	0·676	0·614	0·558	0·508	0·463	0·422	0·386	10
11	0·896	0·804	0·722	0·650	0·585	0·527	0·475	0·429	0·388	0·350	11
12	0·887	0·788	0·701	0·625	0·557	0·497	0·444	0·397	0·356	0·319	12
13	0·879	0·773	0·681	0·601	0·530	0·469	0·415	0·368	0·326	0·290	13
14	0·870	0·758	0·661	0·577	0·505	0·442	0·388	0·340	0·299	0·263	14
15	0·861	0·743	0·642	0·555	0·481	0·417	0·362	0·315	0·275	0·239	15

(n)	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	
1	0·901	0·893	0·885	0·877	0·870	0·862	0·855	0·847	0·840	0·833	1
2	0·812	0·797	0·783	0·769	0·756	0·743	0·731	0·718	0·706	0·694	2
3	0·731	0·712	0·693	0·675	0·658	0·641	0·624	0·609	0·593	0·579	3
4	0·659	0·636	0·613	0·592	0·572	0·552	0·534	0·516	0·499	0·482	4
5	0·593	0·567	0·543	0·519	0·497	0·476	0·456	0·437	0·419	0·402	5
6	0·535	0·507	0·480	0·456	0·432	0·410	0·390	0·370	0·352	0·335	6
7	0·482	0·452	0·425	0·400	0·376	0·354	0·333	0·314	0·296	0·279	7
8	0·434	0·404	0·376	0·351	0·327	0·305	0·285	0·266	0·249	0·233	8
9	0·391	0·361	0·333	0·308	0·284	0·263	0·243	0·225	0·209	0·194	9
10	0·352	0·322	0·295	0·270	0·247	0·227	0·208	0·191	0·176	0·162	10
11	0·317	0·287	0·261	0·237	0·215	0·195	0·178	0·162	0·148	0·135	11
12	0·286	0·257	0·231	0·208	0·187	0·168	0·152	0·137	0·124	0·112	12
13	0·258	0·229	0·204	0·182	0·163	0·145	0·130	0·116	0·104	0·093	13
14	0·232	0·205	0·181	0·160	0·141	0·125	0·111	0·099	0·088	0·078	14
15	0·209	0·183	0·160	0·140	0·123	0·108	0·095	0·084	0·074	0·065	15

Annuity Table

Present value of an annuity of 1 i.e. $\frac{1-(1+r)^{-n}}{r}$

Where r = discount rate
n = number of periods

Discount rate (r)

Periods (n)	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	
1	0·990	0·980	0·971	0·962	0·952	0·943	0·935	0·926	0·917	0·909	1
2	1·970	1·942	1·913	1·886	1·859	1·833	1·808	1·783	1·759	1·736	2
3	2·941	2·884	2·829	2·775	2·723	2·673	2·624	2·577	2·531	2·487	3
4	3·902	3·808	3·717	3·630	3·546	3·465	3·387	3·312	3·240	3·170	4
5	4·853	4·713	4·580	4·452	4·329	4·212	4·100	3·993	3·890	3·791	5
6	5·795	5·601	5·417	5·242	5·076	4·917	4·767	4·623	4·486	4·355	6
7	6·728	6·472	6·230	6·002	5·786	5·582	5·389	5·206	5·033	4·868	7
8	7·652	7·325	7·020	6·733	6·463	6·210	5·971	5·747	5·535	5·335	8
9	8·566	8·162	7·786	7·435	7·108	6·802	6·515	6·247	5·995	5·759	9
10	9·471	8·983	8·530	8·111	7·722	7·360	7·024	6·710	6·418	6·145	10
11	10·368	9·787	9·253	8·760	8·306	7·887	7·499	7·139	6·805	6·495	11
12	11·255	10·575	9·954	9·385	8·863	8·384	7·943	7·536	7·161	6·814	12
13	12·134	11·348	10·635	9·986	9·394	8·853	8·358	7·904	7·487	7·103	13
14	13·004	12·106	11·296	10·563	9·899	9·295	8·745	8·244	7·786	7·367	14
15	13·865	12·849	11·938	11·118	10·380	9·712	9·108	8·559	8·061	7·606	15

(n)	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	
1	0·901	0·893	0·885	0·877	0·870	0·862	0·855	0·847	0·840	0·833	1
2	1·713	1·690	1·668	1·647	1·626	1·605	1·585	1·566	1·547	1·528	2
3	2·444	2·402	2·361	2·322	2·283	2·246	2·210	2·174	2·140	2·106	3
4	3·102	3·037	2·974	2·914	2·855	2·798	2·743	2·690	2·639	2·589	4
5	3·696	3·605	3·517	3·433	3·352	3·274	3·199	3·127	3·058	2·991	5
6	4·231	4·111	3·998	3·889	3·784	3·685	3·589	3·498	3·410	3·326	6
7	4·712	4·564	4·423	4·288	4·160	4·039	3·922	3·812	3·706	3·605	7
8	5·146	4·968	4·799	4·639	4·487	4·344	4·207	4·078	3·954	3·837	8
9	5·537	5·328	5·132	4·946	4·772	4·607	4·451	4·303	4·163	4·031	9
10	5·889	5·650	5·426	5·216	5·019	4·833	4·659	4·494	4·339	4·192	10
11	6·207	5·938	5·687	5·453	5·234	5·029	4·836	4·656	4·486	4·327	11
12	6·492	6·194	5·918	5·660	5·421	5·197	4·988	4·793	4·611	4·439	12
13	6·750	6·424	6·122	5·842	5·583	5·342	5·118	4·910	4·715	4·533	13
14	6·982	6·628	6·302	6·002	5·724	5·468	5·229	5·008	4·802	4·611	14
15	7·191	6·811	6·462	6·142	5·847	5·575	5·324	5·092	4·876	4·675	15

End of Question Paper

Answers

1 Report

To: Board of Iron Chicken (IC)
From: A. Accountant
Date: September 20X5
Subject: Performance management issues at IC

Introduction
This report evaluates the accuracy and assumptions used in the calculation of EVA™. It then suggests new KPIs for the current CSFs at IC. Finally it considers the impact of three quality improvement projects on these CSFs and a proposed new information system.

(i) Economic value added (EVA™)

There are a number of errors in the existing calculation of (EVA™). These are described below and then the corrected EVA™ is calculated.

Non-cash expenses are correctly added back to profit as such costs are treated as unacceptable accounting adjustments on a cash-based view. Marketing activities for long-term benefit are correctly added back as they generate future value for the business and so the prior year expenditure is also added in to capital employed. Research and development (R&D) expenditure should be treated as for the long-term marketing spending (note that there was no R&D expenditure in the prior year). The tax cost in the calculation should be the amount paid adjusted for lost tax on interest and not the adjusted amount of tax charged in the accounts. The WACC is incorrectly calculated as it should be based on the post-tax cost of debt. The capital employed figure should be based on the year start figure.

Economic value added	Year ended 30 June 20X5
	$m
Operating profit	551·4
Add back	
Non-cash expenses	15·1
Marketing capitalised	23·1
Research and development	10·0
Less	
Tax	130·0
Lost tax relief on interest	24·5
NOPAT	445·1
Capital employed	
At 20X5 year start	2,282·0
Marketing spend capitalised from YE 30 June 20X4	23·1
Adjusted capital employed at 20X5 year start	2,305·1

WACC = (1/2 x 16%) + (1/2 x 6·8% x (1 – 30%)) = 10·38%

EVA™ = NOPAT – (WACC x Capital employed) = 206

The recalculated economic value added has increased from $154m to $206m which still indicates a positive position for the company as it adds to shareholder wealth.

In addition to the corrections above, the following assumptions in the calculation require comment:

1. There is an implicit assumption that accounting depreciation (included in operating profit) is equivalent to economic depreciation (which should be used for EVA™ calculations). This is questionable generally, although there is no information to allow a more accurate calculation. Also, there is additional marketing spending which will probably have a limited economic life in building the brand. No estimation of this life and the resulting additional economic depreciation has been attempted in the above calculation.
2. It has been assumed that no amortisation needs to be charged on the research and development costs since the product has not yet launched. This is in line with the accounting treatment of such items.

(ii) Key performance indicators for the critical success factors

Greater staff productivity
The current measure of units produced per labour hour does not reflect the skill and effort which goes into producing different units. The products of IC range from complex to simple and so revenue per employee would better reflect the different skill levels involved in production.

Reduction of wastage
The weakness of the existing measure is that it only looks at one cost area of production (power consumption). Stock obsolescence will measure the wastage due to technological change which is present in the complex products produced by IC.

Greater innovation of products
The number of patents filed will reflect greater innovation at IC. Patents will legally protect groups of products. This will represent a stronger measure of innovation than new products launched since the patent gives legal exclusivity.

[**Tutor note:** *There are many possible acceptable answers to this question, e.g.*

Greater staff productivity
Actual staff hours as a percentage of standard hours for actual production as this would measure staff efficiency in producing a wide range of products.

Reduction of wastage
Input/output analysis of material which looks at the percentage of material purchased which goes into the final product.

Greater innovation of products
Percentage of income earned from products which did not exist last year. This will measure the ability of IC to develop successful products. (The existing measure would record unsuccessful products as innovation.)]

(iii) Lean manufacturing projects

The three projects link together as improvements to the quality of the manufacturing process at IC. There are common elements to these projects in the elimination of waste and empowerment of employees which will occur in the long term. In the short term, there may be increased costs due to these disruptive changes.

Just-in-time manufacturing (JIT)
JIT seeks to produce on a pull-basis to meet the customers' demands rather than to produce products for inventory, which then acts as a buffer between production levels and demand. The main impact of JIT is the reduction of inventory which is held. The main enablers for such a system are a need for close links to customers and suppliers in order to predict demand and to quickly supply that demand. In terms of IC's CSFs, this project will improve productivity as production lines must be made more flexible to meet changes in demand, although it should be noted that there could be a negative impact as constant changes in production lines will require more time to be spent setting up new production runs. It will also help to reduce wastage through losses in inventory as there will be less inventory. It also pushes some of the responsibility for improved quality of components (and reduced wastage) on to suppliers. However, it does not directly impact on product innovation.

The project will not necessarily immediately change any of the existing KPIs as it is about producing the right products at the right time not just more products for any given input and does not impact directly on new product launches.

Use kaizen costing
Kaizen costing aims to reduce current costs of production through continuous improvement. Each period, goals for lower costs are set and then performance monitored against these using variances. At the end of the period, a new lower cost goal is set for the next period. The process also often uses target costing to set the initial planned cost of a product thus incorporating the idea of only producing what the customer values. The purpose is to build into the control of the production process the idea of continuous improvement.

This project has the explicit aim of reducing waste and improving productivity and so is directly linked to the first two CSFs. As a result, it will have an impact on the KPIs which are related to productivity and resource consumption. The project will also require the empowerment of staff to make improvement decisions within their quality circles (teams) and so it may give scope for more innovative thinking. However, this thinking is not aimed at producing new products but at improving the production process, so new product innovation may only be affected indirectly.

Costs of quality and a 'zero defects' approach to manufacturing
Costs of quality can be broken down into four parts:

- prevention costs which occur before or during production and aim to prevent the production of defective products;
- appraisal costs which occur after production and aim to check that products meet quality standards;
- internal failure costs which occur when products are identified as defective before delivery to the customer and so are scrapped or reworked; and
- external failure costs which occur when defective products are delivered to the customer.

The 'zero defects' approach is also known as 'total quality management' (TQM). The TQM philosophy is that it is better to spend money on prevention, which involves challenging all aspects of the production process in order to improve and so avoid failure costs.

This project will affect the CSFs relating to improved productivity and waste by reducing defective products, provided that staff time is not adversely affected by aiming for perfection in production. In terms of the KPIs, it may lead to increased time in production but reduced wastage. It will not have a direct impact on power consumption. Again, this project is unlikely to affect the number of new products launched as it focuses on the production process not product development.

(iv) New information system

The move to a single database for the organisation will integrate the subsystems from different functions (such as production and sales). It will require existing systems to be networked and compatible or else be replaced. It will affect overall decision-making by improving the visibility of each function's operations to the others and to the strategic decision-makers. This shift is often achieved by using an enterprise resource planning system and a strategic enterprise management system.

The unified database will be critical in achieving the goal of JIT manufacturing as close links between production scheduling and demand forecasts will be required in order to match production runs with demand forecasts/orders. Also, the production schedules will need links to inventory levels in warehousing so that inventory is run down before new production is initiated. As closer communication with suppliers and customers will also be required, some change to existing information systems will be necessary in any case. It may be worthwhile to consider including electronic data interchange (EDI) in the specifications of the new system.

In using kaizen costing, cross-functional communication will be important. The design team will need to communicate with the production team so that the design is more easily streamlined for production. The financial systems will need to be frequently updated for information from the quality circles as improvements are made. This will affect the kaizen cost targets which need to be continually monitored and new targets set regularly. Quality circles often involve groups from across the business and so a common information system will facilitate communications amongst them.

The introduction of TQM will require clearer reporting of quality costs to assist in the on-going motivation of staff, which is often a problem in TQM. Informing the quality teams of the impact that increased prevention costs are having on lowering failure costs will be important in maintaining the push to zero defects. The quality improvements and changes to production processes will need to be communicated across IC's different sites which the new database can facilitate.

The nature of the data used in the current system is quantitative but with the new projects, there will be a need to communicate qualitative information, for example, relating to the nature of defects or the new production processes put in place. This will require a fundamental change to existing systems which again motivates the change to a new database.

2 **(a)** The results from both models indicate that Culam is not likely to become insolvent in the next two years. However, there are good reasons to question the applicability of these models to Culam's business and so it would be dangerous to place too much reliance on these results.

A quantitative model such as those presented here identifies financial ratios which significantly differ in value between surviving and failing companies. Statistical analysis is then used to choose the weightings for these ratios in a formula for a score which can be used to identify companies which exhibit the features of previously failing companies. Obviously, the company being analysed must be similar to those being used to build the model for the results to be relevant.

The Altman Z-score was originally developed in the late 1960s and was based on data from US companies, primarily in the manufacturing sector. Therefore, there are three reasons to question the applicability of such data to Culam.

1. The world economy has changed significantly since Altman's original work. The data for this model is now nearly 50 years old.
2. The economy of the USA may not reflect the market in which Culam works.
3. The mining sector is not like general manufacturing, for example, it is highly capital intensive with long periods of no revenue generation.

The Q-score model was based on recent data from Teeland businesses. As for the Z-score, Culam is not likely to be appropriately modelled by such data. The problems are:

1. The Q-score is based on data for Teeland listed companies and Culam is a mining company with an unusual pattern of revenue and costs supplying a global market. It is therefore unlikely to be similar to the companies on the small Teeland exchange, both in its markets and its business model.
2. If Teeland's exchange is small, there may not be much data from failing companies on which to base the model.

Neither of the models addresses factors which may have a large impact on Culam's survival such as world commodity prices and foreign exchange rates.

(b) The lifecycle issues for Culam relate to the long timescale (23 years) for development and use of a mine and the uneven cash flows over this lifecycle.

The initial development phase of two years will require large capital investments with no revenue being generated. There is then a 20-year revenue-generating phase followed by a final year of decommissioning costs with no revenue.

This will impact on the Z-score by making the score very volatile as the mines go through the three phases of their lives.

- During the development phase, total assets are growing while revenue is zero. This will mean that the X5 variable will be zero and the X1 and X3 variables will be falling, thus lowering the score.
- During the working phase of the mine, the total assets will be static or falling (depending on the accounting for reserves) while the revenue is high.
- Finally, during the decommissioning phase, the assets will be falling and again there will be no revenue, so a low Z-score could be expected.

The fact that Culam has only four mines will mean that the phase of any one mine will have a significant impact on the score. If two mines are in development at the same time, then there is likely to be a large effect in lowering the Z-score. It will be the scale of the financial resources which Culam can call on over the life of the mines which will dictate its survival.

(c) The type of action which Culam's board can take to reduce the risk of collapse of the business is to grow the business by buying or developing many more mines, so that the failure of any one project does not bring down the business. Staggering the development of the mines would also help to address this issue.

The board could also seek to alter the proportion of revenues generated from long-term contracts rather than the more volatile spot market. By signing over more of the production to contracts of fixed revenues, the business's cash flows will be more reliable.

The board could learn from the mistakes of their competitors by avoiding over-priced acquisitions or other large project failures by performing suitable due diligence and risk analysis in advance of the investment.

The board could be proactive in managing other major risks by using hedging techniques in order to reduce volatile revenues due to:

– foreign exchange rate changes when the costs of the mines will all be denominated in local currency; and
– commodity prices on the spot market.

Although the use of such techniques will be limited by the availability of long-term hedging contracts.

3 (a) Porter's five forces analysis

Threat of new entrants
The threat of new entrants will be dictated by barriers to entry into the fuel cell market. These appear to be high, given the long timescale and the high levels of technical expertise required to develop a viable product. Also, the developer will need to have cultivated a strong relationship with the major vehicle manufacturers who will be the customers for the product.

A suitable performance measure would be percentage of revenue derived from patented products to measure the legally protected revenues of the business and so indicate the barrier to entry. Stokeness will need to ensure that all technology developments are written up and assessed for their patent possibility.

[*Other measures could include ratio of fixed cost to total cost (measures capital required) or customer loyalty (through long-term contracts to supply fuel cells to manufacturers).*]

Threat of substitutes
The substitutes mentioned in the question are electrical batteries, compressed natural gas and improved existing diesel/petrol engines. However, it is clear that improved diesel/petrol engines would potentially have many lower barriers to cross as the technology is known to the car industry and the infrastructure exists to deliver the fuel to the end-users of the cars.

The threat of each of these substitutes would be measured by an analysis of the comparative cost of creating a viable alternative to the fuel cell. The performance in terms of power output of the engine and emissions reductions compared to price would be critical. Management of this aspect will entail monitoring fuel prices in the market, reviewing the appropriate technical journals and attending conferences in order to identify these threats and their progress. This will require the input of both finance and engineering staff at Stokeness.

Power of suppliers
The suppliers have considerable power. There are rare raw materials used in production and the price and availability of these will dictate possible output levels for fuel cell producers. This is especially important, given the possibility of increased production which could flow if fuel cells become the dominant way to power vehicles in the future. There is a danger that the market in these materials is controlled by a few suppliers who can then dictate price. The engineering subcontractors will also have power through their knowledge of the design elements of Stokeness' product. It will be important for Stokeness to protect this by legally enforceable non-disclosure agreements. There is a danger that this knowledge will lead the suppliers to consider pre-emptive forward integration by taking over Stokeness.

The power of suppliers could be measured by estimating the cost of shifting to an alternative supplier, which could be considerable, given the innovative nature of the technology. These costs would have to include the damage to value from the delay that such a shift would cause.

[*Other measures could include cost of suppliers' product compared to total cost of the fuel cell, which indicates the importance of this component in production, and the number of suppliers as it indicates the level of competition in that market.*]

Power of customers
The customers are the major bus and truck manufacturers. Again, the customers will have a large degree of influence, given their size and limited numbers if Stokeness wants to access the world market. There will need to be a partnership between the fuel cell maker and the vehicle manufacturer in order to ensure that the technologies are compatible. There is the threat that these powerful customers will seek to take over Stokeness if its products prove successful; however, this may be an attractive exit for the shareholders depending upon the price offered.

The power of customers can be measured by estimating their switching costs which are likely to be high, given the technological compatibility issue. However, these costs will only occur once the vehicle manufacturer has agreed to source from a particular supplier (e.g. Stokeness) and until an agreement is reached, the fuel cell supplier will be in the weaker position. The vehicle manufacturer will also have the commercial power to be able to become a new entrant to the market if it appears more profitable to do so.

Stokeness could seek to manage these problems in two ways:

(a) Quickly enter into an exclusive arrangement with one partner by emphasising the technological lead which they hold over the competition. This will be lower risk but will cut returns as the partner will then have pricing power; or

(b) Seek to develop a product which will be attractive to multiple vehicle manufacturers and then maximise price by playing them against each other. This appears less plausible in this scenario, given the limited number of large manufacturers.

[*Other measures could be the number of alternative customers, the level of discounts customers demand and the number of alternative suppliers customers can chose from.*]

Power of existing competition

The power of existing competition appears low as Stokeness has a two-year lead in development. It will be important to protect this legally by patenting innovations as soon as possible and, also, ensuring the strictest commercial confidentiality is maintained within Stokeness and their commercial partners.

The power of existing competitors can be measured by market share once the market forms. However, at this development stage of the industry, a measure such as time to market (the expected commercial launch date of a viable fuel cell) would be more appropriate. This will aid management focus on delivering the product as rapidly as possible, thus maintaining Stokeness' competitive advantage and avoiding time over-runs in development which will strain the cash flows of the company and may lead to unwelcome further calls for funding from the VCs.

[*Other measures could be partnership agreements (with car manufacturers) signed or projected revenues/volumes under such agreements.*]

[**Tutor note:** *The use of ideas such as patent protection, time to market and partnering with a vehicle manufacturer are relevant under several of the headings and credit is given provided the point is suitably justified to the particular force being discussed at that point of the answer.*]

(b) The CEO's concerns over the definition of market in market share are justified, as there are a variety of possibilities.

If Stokeness were to take an ambitious view, then they could measure the market as the total commercial vehicle market and measure the number of vehicles powered by Stokeness' fuel cell compared to the total number of vehicles. This would be a measure of competitive performance against all existing engine technologies including existing petrol/diesel. It would be more realistic to use the number of new vehicles sold rather than all vehicles in existence in this measure. A second possibility exists in this scenario for comparing the number of vehicles with Stokeness' fuel cell compared to the number using any of the alternative engine technologies (fuel cells, electrical, compressed natural gas).

However, Stokeness could take an even less ambitious view and consider just the market for fuel cells, therefore measuring Stokeness' performance against only other fuel cell makers.

The board must make a choice as to the market they are competing in or maybe decide the firms which they see as their main competitors, and then use this to define the market and so the performance measure.

(c) The VCs are likely to be rational investors seeking maximum return for minimum risk. However, they will have invested in a number of companies and so are prepared for investments to fail, provided that some of their investments perform very well. Therefore, they will be risk seeking in technology start-ups such as Stokeness.

The VCs have placed employees within the management team and so have a high degree of influence on Stokeness. They will be looking at medium/long-term returns, given the nature of the project, through net present value based on projected revenues. Of more immediate concern will be the worry that Stokeness runs out of cash before it has a viable product to sell and so cost control measures (variances from budget) and cash outflow will be key measures at present. They will have stated a rough timescale to exit the investment on provision of the initial funds and they will monitor performance to plan on this basis. Progression towards an exit will require Stokeness to pass various milestones (e.g. to file patents, to sign contracts with customers); timely achievement of these would be useful performance indicators, as well as purely financial ones such as meeting the cash flow projections.

1 **(i)** Economic value added
Calculation:
1 mark for each of:
- Research and development
- Tax paid
- Capital employed year start figure
- Non-cash expenses
- Marketing
- WACC
- Economic value added
- Conclusion

Assumptions and corrections – up to 10 marks

Maximum 15 marks

(ii) KPIs for CSFs
Up to 2 marks per CSF

Maximum 6 marks

(iii) Quality projects
Definitions and descriptions up to 2 marks
Analysis up to 6 marks per project

Maximum 15 marks

(iv) New unified database
Definition and general points up to 3 marks
Interaction with each project up to 3 marks each
Other comments up to 3 marks

Maximum 10 marks

Professional presentation: up to 4 marks

Total 50 marks

2 **(a)** 1 mark for general interpretation of calculation
4 marks for general description of how a quantitative model works
Up to 9 marks for problems with the models

Maximum 10 marks

(b) 2 marks for general issues
1 mark for description of lifecycle
6 marks for impact of lifecycle on Z-score

Maximum 7 marks

(c) Up to 2 marks on each improvement – 1 mark for the description of an improvement and 1 mark for the justification

For example:
Increase size of business – portfolio effect
Use of fixed price contracts to avoid volatile commodity prices
Use of FX hedging to avoid revenue volatility
Learn from the mistakes of others – avoid big project failures

Maximum 8 marks

Total 25 marks

3 **(a)** Each force – up to 3 marks for assessment of impact of the external environment on performance management and 1 mark for an appropriate performance measure recommended

Maximum 16 marks

(b) Problems of assessing market share – 1 mark per point

Maximum 4 marks

(c) Assess risk appetite up to 2 marks
Impact on performance measures up to 3 marks

Maximum 5 marks

Total 25 marks