

ENG8104 Asset management in an engineering environment

Assignment 1 – Semester 1 2014

Date due: 09 May 2014

Weighting: 50% (500 marks)

Special Instructions

1. Answer all questions, and ensure that your answers have the coverage, and are in the format, requested.
2. Present your own ideas.
3. Your answers should be properly referenced and reflect that you have undertaken research outside the study material.
4. It is expected that your answers will be produced using electronic word processing. The .pdf format is preferred for written answers. Answers to numerical questions should be produced with an electronic spreadsheet, in which all steps in any calculation should be clearly explained. .
5. Assignments will be submitted using the Electronic Assignment Submission Environment (EASE).
6. There must be a *turnitin* result for the answer to Question 1. Otherwise it will not be accepted. *turnitin* is the plagiarism detection service used by USQ to examine student submissions as they are uploaded to the study desk. If the system does not successfully generate a *turnitin* result, student should try a different file format or contact the course examiner.
7. Please note that if plagiarism or cheating is detected in this assignment it will result in no marks for the assignment. Students should ensure they clearly understand the meaning of plagiarism and cheating. In particular, students should understand that while they may collaborate with other students on the conceptual ideas in their assignments, the final written report submitted by each student must be unique, and must not contain the written material of (a) any other student in the course, or (b) by any other person without due acknowledgement.

Question 1 (300 marks)

Asset Management Strategic Planning

Background

You are an asset manager for a medium sized company, the primary purpose of which is to provide services or products to industrial and/or domestic consumers. Some examples of such an organisation include, but are not limited to:

- Water supply authority
- Sewerage authority
- Road network owner
- Electricity supply company
- Gas supply company
- Telecommunications provider
- Systems network provider
- Power station owner
- Product manufacturer.

Your organisation owns a network of assets that enable it to deliver its services. The assets in the network are of various types, sizes, ages and condition. Because of financial constraints over the past several years, the assets in the network have not been replaced except when absolutely necessary. Maintenance equipment is also not in a generally good condition. Inspection is mainly by visual means, supplemented where required by more detailed investigation.

While a basic asset management system program is in place, few minor assets are recorded on it. Most assets are still located by traditional methods such as links of key reference points (for example, bends, pits, poles, equipment) to property boundaries and centreline distances, building locations, or similar types of reference points. Other asset information is minimal, and is mainly limited to information that is absolutely necessary for maintenance purposes.

There is concern that your organisation's assets are not always located as per your organisation's records. The situation has been exacerbated by poor record keeping in the past, and by not recording changes when there have been changes to property boundaries, ground levels, and the assets themselves.

This poor state of records makes it difficult for other service providers to have sufficient confidence in the information you supply about your assets for their design, construction and maintenance.

Over the past several years, there have been a steadily increasing number of complaints by users of your products as a result of numerous breakdowns in service and failures. Were it not for the fact that there are a number of barriers of entry to the business in which your organisation is engaged (for example, cost, government licences, technology), and the fact that the charges your organisation has levied for usage of its services are cheap compared with similar services elsewhere, your organisation might by now be in considerable difficulty.

With changes in technology and lessening government controls, there are a number of potential competitors entering the market. The rapid technological changes in the assets under your

organisation's control, in asset management processes and methods, and in the types of products delivered by your organisation, are increasingly placing competitors in a position to challenge your organisation to perform.

In search for an answer to what are clearly a number of looming concerns, your organisation has recently appointed you to develop an asset management strategy that meets the board's targets of best industry practice for your particular type of asset network within five years, and a national leadership position within ten years.

Funds – but not unlimited funds - have been made available for this purpose. Your organisation is expecting that the vastly improved standard of service brought by your management skills will bring contented customers who will pay the additional price required for a modern and reliable service.

New technologies are available are expected to assist you to minimise the cost of upgrading your asset, select the best type of maintenance and rehabilitation, and enable your organisation to take a leading position in the asset management field. Other new technologies are likely to enable you to increase the choices available to the consumer and greatly improve the quality of service provided.

Your Task

Write a submission to your chief executive officer of your organisation describing a strategy to review and improve your organisation's assets, their management, and the standard of service which they provide, to achieve the board's goals.

You will need to select the organisation, type of assets and asset network you are managing.

While a real organisation is preferred, you may write your answer for a hypothetical organisation. You should indicate whether the organisation about which you are writing is real or hypothetical.

Your submission should be between 3000 and 4000 words in length and will have, in addition to the body of the report, an abstract, table of contents, background, introduction, conclusion and list of references. Background information should be as brief as possible and include a brief description of your organisation, its asset network, services provided by that asset network, and current state of the network.

At a minimum, your report should address the following specific points (240 marks):

- Background information about the asset network and the assets in it (this should be sufficient to set the scene for the reader) (20 marks)
- The asset life cycle (20 marks)
- Stakeholder expectations (20 marks)
- The outcomes you want to achieve at the end of the five and ten year periods (15 marks)
- Performance and serviceability requirements and indicators (15 marks)
- Development of a reliable asset inventory (15 marks)
- Deterioration and condition monitoring (15 marks)
- How to achieve optimum performance from the asset network (15 marks)
- Current and future technologies (15 marks)
- Development of a corporate asset management plan (15 marks)
- Use of appropriate asset management systems (15 marks)
- Likely benefits and costs (20 marks)
- Conclusion (20 marks)
- Recommendations (20 marks).

A further 60 marks are allocated for communication aspects of your report, as follows:

- Abstract and table of contents (10 marks)
- Structure (10 marks)
- Language and style (10 marks)
- Completion in 3000 to 4000 words (10 marks)
- Setting out and referencing (20 marks)

Comments

It is recommended that you take some time considering a suitable asset type and network on which to write your report. You should then research the selected asset type and its likely network arrangements; and also research processes and methods for managing both the selected asset type and the network. Critically review the information you have found in order to select the most suitable methodology for managing the assets over the next ten years and beyond. Reflect on the possible options and consider a suitable approach for the assets under your control, with the aim of achieving national and ultimately world best practice.

You should review references outside the course material, using both on-line and print resources. On-line resources include both the Internet and library on-line material. For example, the University of Southern Queensland subscribes to a number of on-line databases, which contain abstracts (and often full text) of many current journals.

Question 2

(200 marks)

An asset under your management, with an estimated life of 20 years, costs \$5,060,000 to purchase and install. It has a revenue stream of \$870,000 per year.

Costs of operation and maintenance of the asset are as follows:

Years 1 to 15:	\$320,000 per year for each year
Year 16:	\$380,000
Year 17:	\$430,000
Year 18:	\$550,000
Year 19:	\$700,000
Year 20:	\$900,000

This asset is currently nearing the end of its design life. It therefore should be replaced or rehabilitated. As lead times for ordering equipment and arranging contracts can be quite long, a decision has to be made quickly with respect to the best decision.

There are two options to consider at the end of the 20 year life of the asset:

1. Replacement with a similar asset.
2. Rehabilitation, which will extend its service life by 10 years (i.e., to 30 years in total).

Funds are available for whatever option is selected. There is a lead time of twelve months for ordering and installing a new asset, or undertaking rehabilitation, and therefore a decision on the most suitable option for replacement or rehabilitation is required as soon as possible.

Replacement

If the asset is replaced at the end of its 20 year design life, its residual value then will be \$200,000. It will cost \$550,000 to remove the asset from service when it is replaced.

The replacement is expected to be commenced immediately after the end of the design life of the asset and be completed within a few months of commencement.

During the period of replacement, there will be no disruption to service of the asset. Hence the normal revenue stream will be maintained. Costs of operation and maintenance for the year in which the asset is replaced are expected to be \$420,000, as there will be a period during this year in which the old asset, which has relatively high operation and maintenance costs, will still be functioning.

Under the terms of the replacement contract, all payment for replacing the asset is made after the asset has been successfully replaced.

Rehabilitation

The asset may be rehabilitated after the end of 20 years of service at a cost of \$2,150,000. This process will extend its service life by 10 years (i.e., to 30 years in total).

The rehabilitation process will take up to one (1) year, immediately after completion of the design life of the asset. During the year in which rehabilitation is undertaken, overall costs of operation and maintenance will be \$360,000. For each of the remaining nine (9) years of service of the asset following rehabilitation, costs of operation and maintenance of the asset will be \$440,000 per year.

During the period of rehabilitation, the asset will continue operating, but at a reduced capacity. Revenue received during the year in which rehabilitation is undertaken will be 1500,000. The normal revenue stream will be resumed in the following year.

At the end of the period of operation of the rehabilitated asset, it must be replaced. Its scrap value then will be \$50,000, and there will be a cost of \$600,000 to remove it. Other costs will be the same as those listed above for replacing the asset.

Under the terms of the rehabilitation contract, all payment for rehabilitation of the asset is made after completion of a successful rehabilitation.

Your Task

Part A (80 marks)

Using the net present value method, assess the best option with respect to either rehabilitating or replacing this asset at the end of its life. You should use a spreadsheet, with any necessary explanations, for your calculation.

Money costs 6% per annum. Assume zero inflation. Assume also that for the purposes of analysis, all revenue received and costs incurred in a given year occur at the end of that year.

Assume that once an option for rehabilitation or replacement has been selected that it will be repeated for the second and subsequent asset life cycles following the action taken. For example, if the decision is to rehabilitate at the end of 20 years, then the next life cycle (commencing at an asset age of 30 years) will consist of replacement followed by rehabilitation.

Part B (60 marks)

Repeat your analysis using at least five (5) additional discount rates to the 6% per annum that you used for Part A. The range of these discount rates should be from 3% per annum to 13% per annum.

Plot a graph of Net Present Value against discount rate.

At what discount rate, if any, would the owner of the asset be indifferent with respect to selecting rehabilitation or replacement as the preferred option at the end of the design life of the asset? Briefly discuss your answer.

At what discount rate is rehabilitation not a valid option from the point of view of net present value?

At what discount rate is replacement not a valid option from the point of view of net present value?

What are the implications, if any, of these results?

Part C (20 marks)

Finally, consider (in no more than 400 words) how your answer would be influenced if issues other than economic cost were considered. For example, if the asset was rehabilitated at the end of its useful life, would the reduced capacity of the asset during the rehabilitation process result in the permanent loss of a number of customers, and hence reduced revenue? How would you consider the availability of modern materials with a higher sustainability rating than materials used in the original asset were

available? What if one option (rehabilitation or replacement) better contributed to the community than another? What other issues might be relevant?

Communication (40 marks)

40 marks are allocated to communication aspects of the answer to this question.

Note

You should only consider two options in your answer:

- Rehabilitation at the end of the asset design asset life cycle, followed by replacement by a similar asset which is also rehabilitated at the end of its life cycle.
- Replacement at the end of the asset design asset life cycle, followed by a further replacement.

Assume that all costs and benefits occur at the end of the year in which they occur.

Ignore any costs or benefits incurred after 60 years from the commencement of life of the original asset.

One way of analysing cash flows in situations where cash flows vary from year to year is to initially use first principles to discount each year to a common base year using the compound interest formula. You then have a good basis for further analysis.