CANDIDATE GUIDE

RECOGNISE AND ADDRESS THE REASONABLY FORESEEABLE SOCIAL, CULTURAL AND ENVIRONMENTAL EFFECTS OF COMPLEX ENGINEERING ACTIVITIES

OUTCOME 6

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CANDIDATE INFORMATION

Details	Please Complete details
Name of candidate	
Name of supervisor	
Work Unit	
Name of mentor	
Date started	
Date of completion & Assessment	

COMPETENCY STANDARD REQUIREMENTS

(Direct extract from SAIMechE's Standard of Professional Competency)

LEARNING OUTCOME 6

Recognise and address the reasonably foreseeable social, cultural and environmental effects of complex engineering activities.

Assessment Criteria:

This outcome is normally displayed in the course of analysis and solution of problems. The Candidate typically:

1. Identifies interested and affected parties and their expectations
2. Identifies interactions between technical and social, cultural and environmental factors
3. Identifies environmental impacts of the engineering activity
4. Identifies sustainability issues
5. Proposes and evaluates measures to mitigate negative effects of engineering activity
6. Communicates with stakeholders

Range Statement:

Impacts considered extend over the lifecycle of the project and include direct and indirect effects.

KEYS TO ICONS

The following icons are used throughout the study guide to indicate specific functions:

	**DON'T FORGET/NOTE** **This icon indicates information of particular importance**
	**CANDIDATE GUIDE** **This refers to the learning material in this module which is aligned to the SAIMechE Competency Standard**
	**EXERCISES** **Practical activities to do, either individually or in syndicate groups during the training process**
	**BOOKS AND WEBSITES** **Additional resource information for further reading and reference**
	**SELF TEST QUESTIONS** **Self-evaluation for candidates to test understanding of the learning material**
	**QUOTATIONS** **Quotations which offer interesting points of view and statements of wisdom and insight**
	**YOUR NOTE PAD** **Provided for candidate to document notes during presentation of training**

GENERAL GUIDELINES

PURPOSE

This module provides easy-to-follow steps to help you to recognise and address the reasonably foreseeable social, cultural and environmental effects of complex engineering activities.

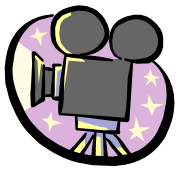
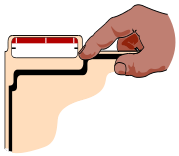
This module introduces you to these concepts and criteria. While it may be impossible and impractical to present in this module all the guidelines pertaining to engineering practice, certain issues of relevance will be highlighted and discussed. You, the candidate, are expected to expand your awareness of this process through workplace projects and further reading and learning.

Candidates will have the opportunity to discuss and debate management during the workshop, and thereby understand and be better equipped to use these concepts and processes in the workplace.

LEARNING OUTCOME AND RANGE OF LEARNING

This programme uses the basic structure of SAIMechE's Competency Standard and specifically the assessment criteria to take you through the process of learning, as an understanding of the assessment criteria and the range of understanding required is fundamental to professional competence.

CANDIDATE SUPPORT

Resources	Candidate Guide 	The Candidate Guide is a manual covering the theory on the comprehension and development of advanced knowledge and provides guidance on practical exercises to meet the requirements of the assessment criteria
	Candidate Portfolio of Evidence Guide	This is a separate document which provides guidelines for Candidates on how to compile their portfolio of evidence, and a template to structure their practical task evidence into a file format for assessment by the mentor/referee
	Books and websites 	Refer to references at the end of the Candidate Guide
	Videos 	Refers to any videos that are regarded as relevant to the subject
	Folder enclosures 	This includes all handouts, checklists, etc. as well as “The Engineer’s Code of Conduct”

SECTION 1

RECOGNISE AND ADDRESS THE REASONABLY FORESEEABLE SOCIAL, CULTURAL AND ENVIRONMENTAL EFFECTS OF COMPLEX ENGINEERING ACTIVITIES

LEARNING OUTCOMES:

- Understand the concept of recognising and addressing the reasonably foreseeable social, cultural and environmental effects of complex engineering activities

1.1. Risk evaluation and impact mitigation

By non-regulatory we refer to social, cultural and environmental issues that may or may not have legally structured components, and where reasonable consideration is given by the engineer to the instances where an engineering activity has impact on these factors. The competent engineer needs to look beyond the limitations prescribed by law, to evaluate whether his/her activities, and any results of them, would have a negative social, cultural or environmental impact, as judged by common sense and a professional perspective. Tools that would be used include those developed within the discipline of risk evaluation and mitigation. The discipline has developed processes that can be learnt and applied.

Candidates should be aware that unforeseen consequences often arise due to the complex nature of social and cultural dynamics.

These risk evaluation and impact mitigation methods consist of the following elements, performed, more or less, in the following order:

1. Identify and characterise the threats
2. Assess the vulnerability of critical activities, and their results, to specific threats
3. Determine the risk (i.e. the expected likelihood and consequences of specific types of attacks on specific assets)
4. Identify ways to reduce those risks
5. Prioritise risk reduction measures, based on a strategy
6. Consider running scenarios with various levels of probability applied to inputs (causes)

1.2. Direct effects

The direct effects of an engineering activity are usually readily identified. Projects are normally the result of a built environment need, from which the public should gain a number of benefits.

Likewise, the investment, engineering, project management, construction, operations and maintenance functions would benefit from the work opportunities and return on investments that are created. Similarly, the negative effects can be evaluated, such as the impact of major road developments on noise in established areas, or the removal of open spaces and natural vegetation that may not be addressed by any formal environmental impact study. Consider the impact of industrial development on urban and rural environments.

1.3. Indirect effects

Indirect effects are not immediately apparent or do not have an obvious link to the engineering activity concerned. An analysis of these hidden or time-delayed effects needs to be done. Experience as a practising engineer is the greatest tutor here, and a great deal can be learned by the Candidate, by spending time discussing the experiences of supervisors, mentors and engineers in senior roles.

1.4. Impact on society

The matter of sustainable development is becoming increasingly relevant, as society takes cognisance of pollution, climate change, waste, recycling, water scarcity, overcrowding, and urbanisation pressures, amongst other issues.

Engineers have a particular responsibility to grasp the essence of sustainability. Engineers are the primary creators of the built environment, and accordingly have a responsibility to not only be aware of the social dynamics that drive change in public expectations, but to analyse and formulate solutions to the challenges of sustainability of the built environment. Sustainability is a word that has been used in many industry mission statements, but in reality the implementation of these missions falls short of a full understanding of the meaning of the

word. MIT has probably advanced the practical meaning of sustainability more than anyone. An extract from MIT's Sloan School is given below.

MIT Sloan believes that sustainability takes root only when economic, social and environmental practices all align to help us flourish indefinitely on a planet with finite resources.

Our Initiative is not simply about solving existing problems. We innovate to create opportunities for greater long-term economic, social, and environmental benefit. We do this by linking sustainability to science, technology, process improvement, organizational learning, entrepreneurship, social change, and finance.

1.5. Impact on the economy

Analysis of, and solution choices for engineering problems will always include financial evaluations to justify the decisions made. Such evaluations will, in the context of the workplace, make a comparison between the cost of implementing the solution and the present value of the benefit of the solution over its life cycle. In this sense, the "economy" is that of the business. However, engineers are, as a profession, responsible for advising on and implementing major projects and programmes that have direct impact on the economy of the country. Engineers have traditionally been absent from the institutions that have authority over many economic matters. For example, how many engineers aspire to and make the necessary effort to become board members of companies or to have political influence? Do engineers, as a profession, organise themselves to advise the government on technical education and training, or to implement the necessary work-place training as a collective to enhance the economic benefits for the country?

The engineer should regard the acquisition of professional status as having the ability and responsibility to venture beyond the strict discipline of applying engineering technology. Engineers must expand their influence within the many social forums that exist.

Traditionally, engineers have not studied economics and finance in an undergraduate capacity as these rarely, if ever, form part of the engineering curriculum. These subjects tend therefore to be studied as a post graduate selective choice by those who have realized that they form an essential part of an engineer's tool set. With the development of virtual learning as a method of study, these subjects can be effectively learnt by the engineer from the enormous volume of material available freely on the internet.

It will become apparent to the engineer that once he enters the workplace and is assigned projects to manage, the dimensions of cost, revenues, budgets, returns, etc. will be *de facto* components of any analysis. The Candidate is thus encouraged to address this matter as an essential tool of his engineering career.

1.6. Impact on the environment

Coupled with the concept of sustainability, engineering has direct impact on many environmental issues. Few projects reach a bankable status today without an environmental impact assessment (EIA). The processes for performing an EIA are well established, but are fraught with what may seem the misguided influences of non-technical interest groups. Engineers need to develop an understanding of the influence of the extreme environmentalist group, and to be able to present well-evaluated, engineering-based cases. The issue of nuclear power must be one of the most relevant and topical.

Typically, an environmental impact assessment will address the following issues:

- to ensure that decisions are taken following timely and sound environmental advice
- to encourage and provide opportunities for public participation in environmental aspects of proposals before decisions are taken
- to ensure that proponents of proposals take primary responsibility for protection of the environment relating to their proposals

- to facilitate environmentally sound proposals by minimising adverse aspects and maximising benefits to the environment
- to provide a basis for on-going environmental management, including through the results of monitoring
- to promote awareness and education in environmental values

Engineers have a collective responsibility to improve the lives of people around the world. The world is becoming a place in which the human population (which now numbers more than six billion) is becoming more crowded, more consuming, more polluting, more connected, and in many ways less diverse than at any time in history. There is a growing recognition that humans are altering the Earth's natural systems at all levels, from local to global, at an unprecedented rate. These changes can only be compared to events that marked the great transitions in the geo-biological eras of Earth's history. The question now arises whether it is possible to satisfy the needs of a population that is growing exponentially, while preserving the carrying capacity of our ecosystems and biological and cultural diversity. A related question is what should be done now, and in the near future, to ensure that the basic needs for water, sanitation, nutrition, health, safety, and meaningful work are fulfilled for all humans. These commitments were defined as the "Millennium Development Goals" by the United Nations General Assembly on September 18, 2000 (United Nations Development Programme, 2003).

Engineers must be aware not only of the legislation that applies to the issue of environmental assessment, but have a social and responsible approach to the concerns expressed in the Millennium Development Goals.

1.7. The rationale for regulation of engineering activities

It is evident from the above items and also by proceeding through the rest of the Outcomes programme, that Engineers have a significant responsibility to ensure that their development of the built environment takes account of many regulatory and non-regulatory issues affecting the public at large.

Whilst Engineers are trained to analyse and resolve problems with an empirical thinking process, the discipline of engineering has evolved standards, benchmarks, criteria, codes and practices that need to be taken into account when engineering activities are performed. In order to ensure acceptable and proven standards for engineering activities, the Engineering Professions Act, No 46 of 2000, was promulgated and forms the basis of the regulation of the profession.

Regulation should not be regarded as having a focus on technical competence only. Via the assessment of the Candidate's ability to comply with the criteria of the Outcomes, the Candidate will be deemed to have gained a level of professional competence and responsibility that *supports* technical competence. In this instance, the adoption of the outcomes-based approach has the advantage of focusing on the ability to perform, by assessment of performed engineering activities and not the degree of education and training of the Candidate. This is a major shift of focus and is a case of the much-maligned OBE (Outcomes Based Education) having a positive impact.

This, however, places a significant degree of responsibility on the Engineer, with the accompanying challenge of having to evaluate and mitigate risk, and take steps to overcome any negative effects of the solutions that are developed.

GROUP DISCUSSION

INITIAL TEST

Complete the Initial Test in Appendix 1 (10 minutes are allocated for this).

SECTION 2

PRATICAL MODEL FOR RECOGNISING AND ADDRESSING THE REASONABLY FORESEEABLE SOCIAL, CULTURAL AND ENVIRONMENTAL EFFECTS OF COMPLEX ENGINEERING ACTIVITIES

LEARNING OUTCOMES:

- Understand the practical steps to be taken when recognising and addressing the reasonably foreseeable social, cultural and environmental effects of complex engineering activities
- Be competent in using the steps
- Be prepared to apply this process in the workplace on a regular and routine basis

2.0. PRATICAL MODEL FOR RECOGNISING AND ADDRESSING THE REASONABLY FORESEEABLE SOCIAL, CULTURAL AND ENVIRONMENTAL EFFECTS OF COMPLEX ENGINEERING ACTIVITIES

2.1. Introduction

The Candidate should have reviewed the contents of Section 1 before proceeding to carry out the steps in this section. Note that each of these steps is aligned with the respective assessment criterion. In this way, the Candidate can focus on the essence of the applicable criterion as the steps are undertaken. Start developing the content of the experience portfolio with these steps.

2.2 Steps

Step 1: Identify interested and affected parties and their expectations

In this step, the candidate is referred to an extensive article on the internet that covers the wide subject of the role that engineering plays in society. It is entitled "*Engineering as a social enterprise*" and is published by the National Academy of Engineering. In particular, Chapter 3 is an excellent study that should provide the candidate with a sound basis for evaluating social and cultural issues. The candidate is encouraged to explore other relevant articles or topics, with the intent of expanding his/her knowledge of engineering's impact on society.

This above is a broad view of the issue. Can the Candidate identify any situation in the workplace where an engineering project is going to have an impact on the workplace or on the

environment of say a client for whom a solution is being sought? Has any consideration been given to the possible unforeseen circumstances that could arise resulting from a solution?

Exercise/ Topic for Discussion

Comment on any of the items raised in the aforementioned, or any other similar study that the candidate has reviewed. (This exercise may or may not be done during the workshop, depending on the time available. If not done during the workshop, it must be done before the next workshop).

Step 2: Identify factors in the technical problem resolution process that have a social or cultural impact

It would be beneficial if the candidate had read the article referred to in Step 1, or any similar study, prior to working through this step. The candidate will most likely be carrying out the exercises for a number of the other Outcomes, and will have analysed and resolved problems where the engineering solution will have a bearing on the issues raised in the article, thus providing real-world experiences for the candidate to use.

The candidate is required to identify any local engineering activities in which he/she has been involved, or has witnessed, that have had an influence on local social or cultural circumstances.

Below is an example of an event that at its conceptual stage created a lot of concern about the related social disruption. This illustrates the need for the engineer to take account of what may be considered to be “non-engineering” issues.

A famous bridge

All engineering projects have some impact on the environment and the people living around the project. For Sydney as a whole, the now famous Bridge helped to open up the northern side of the harbour and allowed the city to expand north.

However, the approaches to the Bridge cut a swathe through fashionable housing on the ridge above the Rocks with the many demolitions, including Dawes Point battery. The battery had been commenced in 1791 to defend Sydney Town and was upgraded several times until 1850. In 1819 Governor Macquarie had engaged Francis Greenway to design fort buildings that would appear as a castle to ships entering the harbour.

The Sydney Harbour Bridge would improve safety, because, prior to its opening, there were 75 ferries per hour between the north and south sides of the harbour. The bridge would replace much of this traffic and would heighten safety for commuters.

In terms of morale the Bridge's value is immeasurable. Built during the Great Depression, it was the lifeblood of the floundering NSW economy. It was not the first large engineering venture in Australia, but it certainly was one of the most recognised, and it showed Sydney, like other great cities around the world, could build a large bridge that symbolically was so much more than a road/rail link north.

It has, ever since its opening, become an icon for Sydney and Australia, and due to its dramatic placement, it has become the centre piece for many celebrations around the harbour. It is arguably one of the most dramatically placed bridges in the world.

Question:
What would you say to a person who was about to lose his home to the bridge? (Engineers have to deal with ethical questions such as these, as well as designing structures like the bridge.)

Exercise/ Topic for Discussion

In this step, the candidate is required to address a particular engineering problem that has been undertaken in the PDP program, or if not available or appropriate, where that candidate has witnessed other engineering-related projects, and to comment on the influence it has or could have on social and cultural factors. (Once again this may or may not be done during the workshop).

Step 3: Identify those factors in the technical problem resolution process that have an environmental impact

Of all the professions, engineering has the greatest influence on both the creation and resolution of environmental problems. The candidate will by now have had some experience of operating in an engineering workplace. While interacting with the various departments of the workplace, and acquiring an understanding of the business trading activities, the candidate would have had the opportunity to observe and evaluate where the activities have had any impact on the environment. This can occur in diverse operations. It may be that a department exhibits a wasteful practice that is taken as the norm and where the candidate evaluates a credible and valuable proposal to vary the practice.

An environmental impact report is a study of all the factors which a land development or construction project would have on the environment in the area, including population, traffic, schools, fire protection, endangered species, archaeological artefacts, and community beauty.

Can the Candidate identify any activity in the workplace where it is evident that the environment is being damaged or unsustainably exploited? Where can it be observed that wastage is apparent? Are there opportunities where recycling could be introduced? Is energy being used unnecessarily? Could the costs of the business be reduced by providing a rationale to do this?

Exercise/ Topic for Discussion

Report on an analysis done within the workplace that addresses environmental factors. There may be issues where the activities have a negative impact on the environment. Are these uncontrolled, or are measures designed into the workplace to eliminate any negative factors? Does the business have an environmental policy and is it being followed? What recommendations can be made? (If not completed during the workshop, this must be completed before the next workshop.)

Step 4: Identify the sustainability issues that are considered when undertaking the analysis of and solution to an engineering problem

Consider the following: What is becoming important to companies is the question of what happens to stuff after it is made. In Europe today, if you make a car, you have to take it back at the end of its lifetime. That is the law. The same is true for a lot of consumer electronics. This is a fundamental shift in the business model. A few companies in Europe led the charge to design these regulations, and they became world leaders in design for re-manufacture and recycling. If you design the car correctly, you can have a lot of value in it even when it's no longer efficient to operate. There are many products that can be evaluated with the same approach.

The above comments clearly apply mainly to manufactured consumer-type products, but the principle applies to the creation of project solutions as depicted in section 1.3, where the systems that produce the products must take into account sustainable processes. The same approach needs to apply to the disciplines that create the built environment in such areas as mining, chemical plants and redundant structures.

Is sustainability an aspect which is understood in the workplace? Could the Candidate do anything to initiate an initiative to introduce the concept and practice in the organisation? Could this Outcome and the assessment criterion be a lever to encourage the Candidate to challenge the current practices in the workplace?

Can the candidate identify any similar circumstances in the workplace where such an approach may be possible? How well can this be researched, and can a solution be proposed, that will be acceptable to the employer?

Exercise/ Topic for Discussion

Try to identify an operation or process in the workplace that goes against the concept of sustainability. Is there potential to re-design a product or process, and if this means short term loss, could it mean long term gain? Can the candidate identify where justifications are short-sighted, where the infamous "quarterly profit" target is the goal of the business? Can the candidate "stick his/her neck out" to challenge the situation that is identified? (To be completed between workshops).

GROUP ACTIVITY

Select one or more of the exercises/ topics for discussion mentioned above, for group discussion.

Step 5: Propose and evaluate measures to mitigate any negative effects of the engineering activity being addressed

With the development of any solution, come the inevitable “unforeseen circumstances” that emerge after the event. All too often these come as a surprise, but experience has shown that applying risk analysis to the solution will reduce the likelihood of such surprises manifesting.

The reason we face these “unknowns” is that we have to contend in life with the combination of variation and uncertainty in most of the parameters that make up any developed solution. There are various approaches to risk assessment (see the References for some examples).

Below is a typical reality that illustrates why all risks need to be addressed in a combined probability scenario. Assume you are assessing the risks associated with starting a new business. For this example, suppose you manage to distil your world down to just ten well-known company “killers”, and you think you've reduced your risk in each category to 10%. Statistically, the situation is as follows:

1. There's a 90% chance that you've identified a genuine market need
2. There's a 90% chance that your addressable market is as big as you think it is
3. There's a 90% chance that you can actually implement your innovation
4. There's a 90% chance that you can figure out how to sell it for more than it costs you to make it
5. There's a 90% chance that you have assembled the right management team to do the job
6. There's a 90% chance that you manage to stay one step ahead of the competition
7. There's a 90% chance that you don't get sued into bankruptcy
8. There's a 90% chance that you won't get buried in regulatory red tape
9. There's a 90% chance that you won't run out of money
10. There's a 90% chance that nothing else goes wrong

You might take comfort in the fact that any one of these risk factors presents only a 10% chance of sinking the company. However, the probability of surviving all ten risk factors (making a technical assumption that the ten risk factors are statistically independent of each other) is: 90% × 90% × 90% × 90% × 90% × 90% × 90% × 90% × 90% × 90% = 35%

Is this then the probability of success of the new business? One can evaluate any solution in a similar way. Clearly the challenge is to assess the number of contributory factors that affect the solution and evaluate the dependency of these factors.

Does the Candidate agree with this approach and if so find opportunities in the workplace where it could be demonstrated, or where history has confirmed that this probability of risk was ignored? What other approaches to the evaluation of risk could be used?

Exercise/ Topic for Discussion

Identify an engineering problem and solution that you have developed, or one about which you are familiar, and carry out an assessment of the negative factors that have emerged, or could emerge. Propose measures that could be applied to mitigate the number of negative impacts, and/or their severity. Identify any risk mitigation process you may have used. (To be done between workshops).

Step 6: Communicate with stakeholders

The term stakeholder has become somewhat overused, and often implies that anybody or any bodies associated with the event are stakeholders, with an interest in the event. It follows that they must be consulted or involved in the outcome. How often have we observed projects being inordinately delayed or exceeding budgets and timelines due to stakeholders becoming involved?

The various stakeholders, therefore, need to be identified in any problem resolution, and the roles that they play defined. It is then necessary to decide what form of involvement and communication is appropriate for each.

A Guide to the Project Management Body of Knowledge (PMBOK® Guide) defines a stakeholder as a person or organization that:

- Is actively involved in the project
- Has interests that may be positively or negatively affected by the performance or completion of the project
- May exert influence over the project, its deliverables, or its team members

Here are some of the different stakes a person or organisation may have (most have more than one):

Interest:	To be affected by a decision related to the work or its outcomes
Rights:	To be treated in a certain way or to have a particular right (including legal or moral) protected
Ownership:	To have a legal title to an asset or a property
Knowledge:	To possess specialist or organisational knowledge needed for the work
Impact or influence:	To be impacted by the work or its outcomes, or have the ability to impact (or influence) the execution of work or its outcomes
Contribution:	Relating to the support or assets including the supply of resources, the allocation of funding, or providing advocacy for the objectives of the project

Once you understand the stake the stakeholder is seeking to protect, profit from or enhance, you can structure your communications to let the person know you understand their hopes or concerns. From this starting point, you're in a much better position to manage the relationship to the benefit of both the project and the stakeholder.

One way to characterize stakeholders is by their relationship to the effort in question:

- Primary stakeholders are the people or groups that stand to be directly affected, either positively or negatively, by an effort or the actions of an agency, institution, or organisation. In some cases, there are primary stakeholders on both sides of the equation: a regulation that benefits one group may have a negative effect on another. A rent control policy, for example, benefits tenants, but may hurt landlords.
- Secondary stakeholders are people or groups that are indirectly affected, either positively or negatively, by an effort or the actions of an agency, institution, or organisation. A program to reduce domestic violence, for instance, could have a positive effect on emergency room personnel by reducing the number of cases they see. It might require more training for police to help them handle domestic violence calls in a different way. Both of these groups would be secondary stakeholders.
- Key stakeholders, who might belong to either or neither of the first two groups, are those who can have a positive or negative effect on an effort, or who are important within or to an organisation, agency, or institution engaged in an effort. The director of an organisation might be an obvious key stakeholder, but so might the line staff – those who work directly with participants – who carry out the work or who make the effort. If they don't believe in what they're doing or don't do it well, it might as well not have begun. Other examples of key stakeholders might be funders, elected or appointed government officials, heads of businesses, or clergy and other community figures who wield a significant amount of influence.

Exercise/ Topic for Discussion

Identify a project or event in your workplace where you can address the stakeholders, or those you deem to be stakeholders, that may or may not have been formally considered. Articulate their roles, how they were involved, in what way communication took place, and whether or not a conclusion or agreement was reached with respect to their roles? (To be done between workshops).

ASSESSMENT TEST

Complete the Assessment Test in Appendix 1 (30 minutes are allocated for this).

SMALL GROUP ACTIVITY

Split into two groups and refer to the discipline-specific case study in Appendix 2.

CLASS DISCUSSION

Discuss Case Studies (Appendix 2) and Programme administration.

SECTION 3

GENERIC GUIDING PRINCIPLES

GENERIC GUIDING PRINCIPLES

1. Competency Standard

The SAIMechE Competency Standard is the fundamental document underpinning the journey to Professional Competence. It is the foundation document informing all aspects of the training programme that relates the requirements of competency to the working environment of the developing engineer. It is the standard of practice against which all activities of a competent and professional engineer are measured.

2. Outcomes

The eleven outcomes are the fundamental building blocks on the path to competency. A demonstration of understanding of these outcomes as they relate to the day-to-day working environment will indicate that a level of competency has been reached which will enable the candidate to function at a professional level within the commercial and business environment.

3. Assessment Criteria

The assessment criteria are the requirements against which the candidate is evaluated in order to determine understanding and competency. These are objective criteria which will ensure capability and transparency, and set a standard that ensures a proficient level of competency and professionalism as required by industry, and in the interests of public health and safety.

4. Range Statements

The range statements set the boundaries of the requirements of each outcome and determine the limits of competency as required for professional practice.

APPENDICES

APPENDIX 1

ASSESSMENTS/TESTS

INITIAL TEST (SECTION 1)

1. How would you describe non-regulatory risks?

2. What measures would you employ to evaluate these risks?

3. List some of the *direct* environmental, social and cultural effects that would need to be considered during an engineering project.

4. Identify some of the *indirect* environmental, social and cultural effects that would need to be considered during an engineering project.

5. What do you understand by the term “sustainable” in in terms of the built environment?

6. Do you believe that Engineers can have an impact on the economy beyond their specific business focus? If so, in what way could Engineers play a more visible social role?

ASSESSMENT TEST (SECTION 2)

1. Which parties do you consider to typically be affected by engineering problems?

2. Can you recall any situation in your own experience where you witnessed the impact of poor engineering judgment on the affected parties?

3. We read about the Sydney Harbour Bridge and how its development survived the initial negative impacts. If it was being proposed today, how should Engineers be involved in the public relations attached to it?

4. Sustainability appears to be moving towards the practice of designing for re-use of the materials after the useful life of the product has expired. Can you suggest any products that you believe should be managed the same way? If so, what is your rationale?

5. Which two realities (nouns) affect risk in resolving complex engineering problems?

6. What do you understand to be the roles of stakeholders?

7. Are you able, in your own words if necessary, to recall and list below the 6 assessment criteria that apply to Outcome 6?

APPENDIX 2: CASE STUDIES

REFERENCES

Websites:

Engineering as a social enterprise
http://www.nap.edu/openbook.php?record_id=1829&page=73

MIT on sustainability
http://sloanreview.mit.edu/article/sustainability-its-not-what-you-think-it-is/

Which risk assessment tool should I use?
http://mines.industry.qld.gov.au/assets/mines-safety-health/3_risk_assessment_-_which_tool_do_i_use.pdf

Risk assessment techniques
http://scholar.google.com/scholar?q=risk+assessment+techniques&hl=en&as_sdt=0&as_vis=1&oi=scholart&sa=X&ei=18QlUv7gItOThQfanIEY&ved=0CCsQgQMwAA

Mechanical Engineer's DSTG document
http://www.ecsa.co.za/documents/NewReg/R-05-MEC-PE.pdf

Engineering for the developing world
http://www.engineeringchallenges.org/cms/7126/7356.aspx

Environmental Impact Assessment
http://en.wikipedia.org/wiki/Environmental_impact_assessment

RECORDING OF REPORTS

Formats for recording the portfolio of evidence

During the course of the candidate phase training, the Candidate will accumulate a portfolio of evidence comprising the reports supporting the various exercises covered in these guidelines for each Outcome.

Note that the PDP Administration will provide a web site document system that will allow the candidate to store all the PDP documents created as a back-up facility and will enable the candidate to allow access by the Mentor for any reviews that are required.

ASSESSMENT PROCESS

Guide to the Candidate

You will be assessed against Outcome 6.

In order to determine your level of competence you will be tested by:

- Tests done during the workshop and evaluated by fellow candidates and your mentor
- Written assignments (practical tasks given to demonstrate understanding of this Outcome through application in a work setting)
- Knowledge assessment and presentation (i.e. 10 minutes oral presentation using Power Point). Please Note: Oral presentations may need to be taped for moderation and re-assessment procedures.

You will need to prepare yourself in the following ways:

- Familiarise yourself with the contents of this guideline
- Familiarise yourself with the reporting formats required
- Familiarise yourself with the references listed
- Do the written assignments as required by this workshop
- For oral presentations of reports, a ten minute presentation is required to summarise the exercise performed

Note:

A detailed briefing on the exact requirements was given to you by the Mentor/Assessor at the Introductory Workshop in order for you to prepare for the assessment process.

The evidence you will be judged on includes:

- Your proven competence in all areas questioned in the presentation (Competent or Not Yet Competent)
- The practical tasks compiled in your Portfolio of Evidence

Good luck, and remember, the mentor/assessor is there to help you.