CANDIDATE GUIDE

MEET ALL LEGAL AND REGULATORY REQUIREMENTS AND PROTECT HEALTH AND SAFETY OF PERSONS IN THE COURSE OF EXECUTING COMPLEX ENGINEERING ACTIVITIES

OUTCOME 7

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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 7

Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his or her complex engineering activities.

Assessment Criteria:

The candidate is expected to:

1. Identify applicable legal, regulatory and health and safety requirements for the engineering activity
2. Select safe and sustainable materials, components and systems
3. Identify risk and apply defined, widely accepted risk management strategies

Range Statement:

Requirements include both explicitly regulated factors and those that arise in the course of particular work. Persons whose health and safety are to be protected are both inside and outside the workplace.

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 meet all legal and regulatory requirements and protect the health and safety of persons in the course of your complex engineering activities.

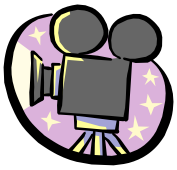
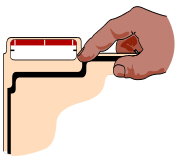
The purpose of the module is to introduce to the engineer a practical methodology for meeting the requirements of the assessment criteria to comply with Outcome 7.

The approach to this module is by no means restricted to these guidelines only, and the Candidate is expected to research any appropriate references, literature and practices that can support the essence of this competency outcome.

LEARNING OUTCOMES 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 depth of understanding required is fundamental to professional competence.

CANDIDATE SUPPORT

Resources	Candidate Guide 	The Candidate Guide is a manual covering the theory of 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
	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. e.g. The “Engineer’s Code of Conduct”

SECTION 1

MEET ALL LEGAL AND REGULATORY REQUIREMENTS AND PROTECT HEALTH AND SAFETY OF PERSONS IN THE COURSE OF EXECUTING COMPLEX ENGINEERING ACTIVITIES

LEARNING OUTCOMES:

- Understand how to identify the legal, regulatory and health and safety requirements for an engineering activity
- Be aware of the need to identify the above factors, and mitigate any risks associated with them

1. MEET ALL LEGAL AND REGULATORY REQUIREMENTS AND PROTECT HEALTH AND SAFETY OF PERSONS IN THE COURSE OF EXECUTING COMPLEX ENGINEERING ACTIVITIES

1.1. Explicit regulatory requirements - essential items

Explicit regulatory requirements that apply to engineering activities are to be found in Acts and Regulations of Parliament. The Candidate is expected to have reviewed the contents of these regulatory documents in order to gain a working knowledge of them, and to be able to identify the applicable regulations that would apply to any engineering activity carried out by the Candidate in the course of this programme and during ongoing engineering activities. The requirements in these Acts and Regulations, and other related documents, may need to be assessed for application to each particular engineering activity. For example, an Act may make reference to Regulations that need to be reviewed, and which normally contain specific criteria that may be changed by the authority under which the regulations fall, without the need to amend the Act. The Candidate will find that the many of the CPD course topics offered will address regulatory issues, and this provides a good process to keep up to date with the requirements.

1.2. Explicit regulatory requirements – general items

Other related documents may need to be assessed for application to engineering activities. General requirements would be those that define good practice, as determined within the profession, and which are not specifically covered in legally binding statutes.

An example here would be the good configuration, recording and filing of design data in such a way that it can be accessed and used by others, or where its relevance and access is critical to operational activities. It is not uncommon to find that, for example, a business has either mislaid the as-built data and information on the assets that it

operates, so that when there is a need for modifications or maintenance, the baseline cannot be determined. Similarly, when changes are made, have change management procedures been implemented and followed? Although standards are provided to guide this process under the discipline of configuration management, this is not treated as a legal requirement, but should be regarded as good engineering practice. For this reason, a reference is provided to assist the Candidate to understand what configuration management is about, and the need for it to be understood and practiced across all engineering operations.

Other examples that the Candidate should study are copyright rules, rules of plagiarism, and requirements to acknowledge references that are made, as these issues will frequently be relevant to the work of the engineer.

1.3. Sustainable materials

One could well ask why society should be concerned that materials should be sustainable. This question has many answers, as the definition of sustainable is still an uncertain one that is the subject of considerable research and debate. Valuable guidelines on the approach to sustainability can be learned from the book by Peter Senge of MIT, “The Necessary Revolution: How Individuals and Organizations are Working Together to Create a Sustainable World”. The book follows topics such as the following:

Companies will start with some combination of waste reduction and then just get engaged. From there, they move into longer-term stuff, which is really where the action is. That’s creating new products, thinking about this in terms of the product portfolio, the product pipeline, and even the technology underpinnings. DuPont has shifted something like 25 percent to bio-based feedstock, moving out of petrochemical feedstocks, because they just don’t want to be downstream of the oil business forever. It’s a very long-term investment, but they’re doing it systematically and their goal is to be about 50 percent

bio-feedstock in about 10 years. Or GE, with its Ecoimagination products, trying to develop a whole product line around more energy efficient motors.

It thus becomes necessary for engineers to adopt a mindset that considers the issue of sustainable materials. This may mean selecting a higher-cost material for an engineering solution to provide an overall lower lifecycle cost for the solution, obviating replacement or excessive maintenance or costs of de-commissioning or recycling.

Herein lies a real challenge to engineers. Whilst they may have evolved the appropriate technological solutions, the human "ego" factor remains obstinate: the project team does not wish to include costs at the project stage that increases their component, even though it decreases the cost over the life cycle of the project. Until clients (owner's team) have this vision and apply it, it will not materially change. Does this offer competent professional engineers the opportunities to play bigger roles on executive teams and company boards?

1.4. Sustainable systems

The concept of a sustainable system is one where the entire process has been taken into account in determination of sustainability. Good examples of this are being illustrated by the realization across many societies and industries that water consumption cannot carry on at its present rate. Water is rapidly becoming a limited resource. Many industries are really quite close to their resource base - food and beverages, for instance. Coca-Cola and Nestle, two corporations that rarely collaborate much on anything, jointly created the CEO Water Mandate, because they've come to realize that water is the most acute issue in the world today, and many countries where they hope to grow are areas of acute water shortage. They've had a wakeup call that if there isn't a more integrative management of watershed in the world, their license to operate and grow as a business is ultimately going to be at great risk.

This issue of sustainability is a major challenge for engineers because, like most people in the world, they are just focused on their careers. They have their tracks set out in their minds; they're climbing the ladders. Short-term thinking of management and investors makes it tough to be any sort of pioneer in promoting sustainability. But engineers can lead the way because few others will do so. It must be seen as the competent professional thing to do.

1.5. Long term vision for sustainability

Sustainability is, by nature, a concept that requires long term vision. It is a concept that fits with the engineer's challenge for life-cycle engineering, starting with the analysis of the problem, and making the correct assumptions. These assumptions must include socio-economic, safety and environmental factors, in addition to the normal material and labour input costs, which are frequently the only parameters being considered in a design. Candidates should consider how they would handle an issue such as producing a design that takes into account lower operating costs of a project or plant, but requiring a higher capital investment at the design and construction stage. Commonly in this scenario, the project manager wishes to spend as little as possible and has no common vision with the operating issues and costs. A lot of hollow commitment is given to life-cycle costing by project managers, but in reality it does not materialize. Vision rarely extends beyond one's own personal planning horizon. engineers will constantly come up against the goal of the project team: lowest cost to build, and the goal of the operations and maintenance team: lowest cost to operate and maintain. The two rarely have the same goal: lowest lifecycle cost. There is a conflict here and elsewhere in this programme we will try to address the issue of resolution or evaporation of conflicts.

The following is a comment by Peter Senge in an interview with the Editor of the Sloan Management Review journal on the topic of sustainability:

In the last year or two, everything has changed. People are starting to suspect that these are really strategic issues - that they will shape the future of our businesses. The

specifics are all different, depending on industry and context, but we're in the beginning of an historic wakeup.

Undoubtedly, climate change has been the straw breaking the camel's back. A lot of people think of climate change as a technical problem, something that's going to be fixed by technical solutions. But more and more people are starting to realize that it's not going to be fixed, except as a byproduct of a real shift in how the whole industrial system operates.

I'm guessing that in the next six months people will have an even better handle on that. We're right in a moment when the issue is moving from something marginal, something that we think somebody else needs to worry about, to something more personal.

Senge's commentary has been visionary. Whether society likes it or not, it will be compelled to adopt an ethos of sustainability. When it comes to the built environment, this places the issue squarely in the domain of the competent professional engineer.

1.6. Impact of the regulations

Regulations form a level within the hierarchy of statutory requirements. In practice, the engineer is required to ascertain which of the Acts and Regulations have application to the specific activity being undertaken. Other than the overarching impact of common law, two particular items of legislation need to be familiar to engineers in SA insofar as the impact on daily activities is concerned.

These are the Occupational Health and Safety Act (Act No 85 of 1993) and the Mines Health and Safety Act (Act No 29 of 1996), both as amended. In particular, the Certificated Engineer will need to have specific and in-depth knowledge of these two Acts for the certifications "Factories" and "Mines and Works". These are currently acquired via the curriculum and examinations set by the Department of Labour and The Department

of Mineral Resources. It is of note that these qualifications are unique to South Africa and were the result of the work following the development of mines in the early 1900s.

These Acts make reference to Regulations which can be amended from time to time. These regulations are in fact the essence of the legislation, in that they refer to specific requirements that need to be followed for such matters as safety and the need for the levels of qualification required for various amounts of power consumption and generation.

Non-compliance with the safety standards in these Acts and Regulations can mean that lives are in danger, work activities can be halted and legal action taken against the responsible parties.

GROUP DISCUSSION

Select a topic for discussion:

1. Why is it necessary for society to have Acts of Parliament and regulations?
2. Is climate change the result of human activity or just a natural cyclical weather phenomenon?
3. Is sustainable development important, or can the earth adjust to the rising demands of the consumers?
4. Energy demands drive industrial development. Is this true and, if so, what role can engineers play in future developments of sustainable energy production methods?
5. Would nuclear energy be a more environmentally-friendly alternative to the use of coal as a fuel?

INITIAL TEST

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

SECTION 2

PRACTICAL MODEL FOR MEETING LEGAL AND REGULATORY REQUIREMENTS

LEARNING OUTCOMES:

- Understand the practical steps to be taken when meeting all legal and regulatory requirements and protecting the health and safety of persons in the course of executing complex engineering activities
- Be competent in using these steps
- Be prepared to apply this process in the workplace on a regular and routine basis

2.1 STEPS FOR MEETING ALL LEGAL AND REGULATORY REQUIREMENTS AND PROTECTING HEALTH AND SAFETY OF PERSONS IN THE COURSE OF EXECUTING COMPLEX ENGINEERING ACTIVITIES

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 Portfolio of Evidence (POE) with these steps.

The assessment steps:

STEP 1: Identify applicable legal, regulatory and health and safety requirements for the engineering activity

STEP 2: Select safe and sustainable materials, components and systems

STEP 3: Identify risk and apply defined, widely accepted risk management strategies

STEP 1: Identify applicable legal, regulatory and health and safety requirements for the engineering activity

In practice, the engineer is required to ascertain which of the Acts and Regulations have application to the specific activity being undertaken.

For this step, it is recommended that the Candidate evaluates the project at hand and considers what areas may be impacted by, or have some relationship to, any existing legislation. This may require a legislation search, based on the Candidate's awareness

of current legislation, plus a search for unknown links. It may be necessary at this point to acknowledge the limitations that the Candidate has, and call upon the assistance of a legal expert. The concept of calling for expert assistance when one reaches the limits of one's competency is imbedded in "The Engineer's Code" which is covered extensively in Outcome 8, "Conducts his or her engineering activities ethically".

Exercise/ Topic for group discussion

(These exercises/topics for group discussion can be done outside the workshop, as the time allocated will not allow for their completion at the workshop.)

> OHSAct (Act 85 of 1993) Section 8 2(d)
>
> Establishing, as far as is reasonably practicable, what hazards to the health or safety of persons are attached to any work which is performed, any article or substance which is produced, processed, used, handled, stored or transported and any plant or machinery which is used in his business, and he shall, as far as is reasonably practicable, further establish what precautionary measures should be taken with respect to such work, article, substance, plant or machinery in order to protect the health and safety of persons, and he shall provide the necessary means to apply such precautionary measures;

Study the extract from the OHSAct and discuss what the implications of the above statement are with particular reference to the words "hazard", "risks" and "precautionary methods". Further comment on what implications this regulation would have on any project you are currently working on.

STEP 2: Select safe and sustainable materials, components and systems

As mentioned earlier, the implementation of sustainable solutions is a new science that has a long way to go. Traditions die hard. Converting business and society to implement what will probably be radical changes, takes more time than is expected, as we have a common trait, and that is to practice optimism bias. Our industry is littered with projects that take longer and cost considerably more than originally planned. When injecting the radical concepts of sustainability, this will inevitably aggravate the process. Sustainability, to the engineer, will mean adopting a life-cycle philosophy which will mean questioning the use of traditional materials or the way we dispose of them. It will mean varying processes and economic projections as well as the awareness of and application of revised regulations, both statutory and unregulated good practice. It will include the challenge of implementing change.

There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.

Niccolo Machiavelli (died 1527)

On the other hand, consider this:

Entrepreneurs are simply those who understand that there is little difference between obstacle and opportunity and are able to turn both to their advantage.

Niccolo Machiavelli (died 1527)

This era, however, brings considerable opportunity to the engineer, to take command and apply knowledge, experience and enterprise in forging a new order of sustainability.

Exercise/ Topic for discussion

Identify any activity in the workplace which you consider could be reviewed for the adoption of a sustainable solution that meets economic, regulatory and social metrics. If this is not available, select any situation of which you are aware and which has meaning to you.

GROUP DISCUSSION

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

STEP 3: Identify risk and apply defined, widely-accepted risk management strategies

This activity will be the test of the process used by the engineer to evaluate the extent or degree of risk associated with a proposed solution. It will inevitably involve the interrogation by others, because it has brought the project to finality. The rationale will have to be available and clearly justified. The engineer should be quantifying the risk associated with the solution over its life cycle. It will be the time for bold confidence in the analysis and synthesis used to reach the solution. All too often the projection of risk on a quantified basis is not bounded by specific measures. A statement such as the

following is, in real terms, meaningless: “The plant discharge will need to be monitored for acidity on a regular basis”. Two risk metrics are undefined here. The level of acidity limits or range is not stated, and the frequency of “regularly”.

Thus this would best be stated: “The plant discharge must be monitored every 12 hours and the acidity level must be limited to a pH not exceeding 6. Should this at any time be reached, the plant discharge must be redirected to the holding tanks and the reasons for the excursion determined in accordance with procedure number xx”. This approach defines the appropriate metrics, the mitigating action and the corrective action required. The risk is thus managed.

Exercise/ Topic for discussion

The Candidate is to select a project, preferably within the work place environment, where the issues of direct and indirect risk have been identified. If an example is not locally available, then the Candidate is to seek a project from any engineering-related source. The exercise is to locate the content that addresses risk issues and to analyse them

ASSESSMENT TEST

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

GROUP ACTIVITY

Report and 10 minute presentation evaluation.

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. What do you understand by “Acts and regulations”, referred to in this Outcome?

2. How would you differentiate between an Act and a Regulation? Provide examples.

3. Provide, in your own words, the definition of sustainable as it applies to the role of the engineer. In what areas do you feel engineers can influence the cause of sustainability?

4. Identify any particular resources that you consider to be under threat as a result of current policies or activities that should be changed as a priority?

5. In the consideration of 4 above, specify a change of practice that you consider would assist with making a change to a more sustainable solution.

ASSESSMENT TEST (SECTION 2)

1. You are requested by a superior to carry out some engineering work for which you do not regard yourself as competent to do. How would you manage that situation?

2. In the challenge to move towards a sustainable environment, the engineer is presented with many difficulties. What do you consider to be a significant hurdle for engineers to overcome?

3. What would you consider hazards and risks in your current workplace?

4. In the challenge to move towards a sustainable environment, the engineer is presented with many difficulties. What do you consider to be a significant hurdle for engineers to overcome?

5. In the challenge to move towards a sustainable environment, many opportunities could be identified. Can you suggest any that may provide such an opportunity to yourself?

6. Risks associated with poor upkeep of an original asset, or facility, are common. Identify where, in your judgment, there are any significant cost and safety-related risks associated with any area in your workplace. If not evident, select any other instance you are aware of where engineering activity has been involved.

7. In your own words, list the three Assessment Criteria that apply to this Outcome.

APPENDIX 2: CASE STUDIES

REFERENCES

Websites:

Configuration Management
http://as9100store.com/downloads/ISO-10007-Configuration-Management.pdf

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

The necessary revolution
http://www.randomhouse.com/book/163986/the-necessary-revolution-by-peter-m-senge-bryan-smith-nina-kruschwitz-joe-laur-and-sara-schley

The Engineering Professions Act in South Africa
http://www.ecsa.co.za/documents/EngProfAct46_2000.pdf

Occupational Health and Safety Act no 85 0f 1993
http://www.info.gov.za/view/DownloadFileAction?id=71092

Guide to the various Regulations that apply to the OSHACT
http://www.labourguide.co.za/health-and-safety/health-and-safety-downloads-848

Plagiarism, Citation and Referencing Styles
http://libguides.wits.ac.za/content.php?pid=165338&sid=1394753

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 7.

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.