ENGINEERS
AUSTRALIA

STAGE 1 COMPETENCY STANDARD FOR ENGINEERING TECHNOLOGIST

ROLE DESCRIPTION - THE MATURE, ENGINEERING TECHNOLOGIST

The following characterises the senior practice role that the mature, Engineering Technologist may be expected to fulfil and has been developed from the role portrayed in the *Engineers Australia - Chartered Status Handbook*. This is the expectation of the development of the engineer who on graduation satisfied the Stage 1 Competency Standard for Engineer Technologist.

Engineering Technologists normally operate within broadly-defined technical environments, and undertake a wide range of functions and responsibilities. They are often specialists in the theory and practice of a particular branch of engineering technology or engineering-related technology (the technology domain), and specifically in its application, adaptation or management, in a variety of contexts. Their expertise often lies in familiarity with the current state of development of a technology domain and most recent applications of the technology. Within their specialist field, their expertise may be at a high level, and fully equivalent to that of a Professional Engineer. Engineering Technologists may not however, be expected to exercise the same breadth of perspective as Professional Engineers, or carry the same wide-ranging responsibilities for stakeholder interactions, for system integration, and for synthesising overall approaches to complex situations and complex engineering problems.

The work of Engineering Technologists combines the need for a strong understanding of practical situations and applications, with the intellectual challenge of keeping abreast of leading-edge developments as a specialist in a technology domain and how these relate to established practice. For this purpose Engineering Technologists need a strong understanding of scientific and engineering principles and a well-developed capacity for analysis. The work of Engineering Technologists is most often concerned with applying current and emerging technologies, often in new contexts; or with the application of established principles in the development of new practice. They may also contribute to the advancement of technology.

Engineering Technologists frequently will take responsibility for engineering projects, services, functions and facilities within a technology domain, for specific interactions with other aspects of an overall operating context and for managing the contributions of their specialist work to a broader engineering system or solution. In these roles, Engineering Technologists must focus on sustainable solutions and practices which optimise technical, social, environmental and economic outcomes within the technology domain and over a whole systems life cycle. They will have an intimate understanding of the standards and codes of practice that underpin the technology domain and ensure that technology outcomes comply with statutory requirements. Engineering Technologists are required to interact effectively with Professional Engineers and Engineering Associates, with other professionals, tradespersons, clients, stakeholders and society in general, to ensure that technology outcomes and developments fully integrate with the overall system and context.

Engineering Technologists must ensure that all aspects of a technological product, or operation are soundly based in theory and fundamental principle. They must understand how new developments relate to their specific field of expertise. They will be often required to interpret technological possibilities, to investigate interfaces, limitations, consequences, costs and risks.

Engineering Technologists may lead teams responsible for the implementation, operation, quality assurance, safety, management, and maintenance of projects, plant, facilities, or processes within specialist practice area(s) of the technology domain. Some Engineering Technologists may establish their own companies or may move into senior management roles in engineering and related enterprises, employing Professional Engineers and other specialists where appropriate.

STAGE 1 COMPETENCIES

The three Stage 1 Competencies are covered by 16 mandatory Elements of Competency. The Competencies and Elements of Competency represent the profession's expression of the knowledge and skill base, engineering application abilities, and professional skills, values and attitudes that **must be demonstrated** at the point of entry to practice.

The suggested indicators of attainment in Tables 1, 2 and 3 provide insight to the breadth and depth of ability expected for each element of competency and thus guide the competency demonstration and assessment processes as well as curriculum design. The indicators should not be interpreted as discrete sub-elements of competency mandated for individual audit. Each element of competency must be tested in a holistic sense, and there may well be additional indicator statements that could complement those listed.

Definitions of terms used in the statements of the Competencies and Elements of Competency follow those used by the International Engineering Alliance in Section 4 *Common Range and Contextual Definitions* of *Graduate Attributes and Professional Competencies* Version 2 - 18 June 2009, available at
http://www.washingtonaccord.org/IEA-Grad-Attr-Prof-Competencies-v2.pdf

STAGE 1 COMPETENCIES and ELEMENTS OF COMPETENCY

1. KNOWLEDGE AND SKILL BASE

1.1. **Systematic, theory based understanding** of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain.

1.2. **Conceptual understanding** of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the technology domain.

1.3. **In-depth understanding** of specialist bodies of knowledge within the technology domain.

1.4. **Discernment** of knowledge development within the technology domain.

1.5. **Knowledge** of engineering design practice and contextual factors impacting the technology domain.

1.6. **Understanding** of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the technology domain.

2. ENGINEERING APPLICATION ABILITY

2.1. **Application** of established engineering methods to broadly-defined problem solving within the technology domain.

2.2. **Application** of engineering techniques, tools and resources within the technology domain.

2.3. **Application** of systematic synthesis and design processes within the technology domain.

2.4. **Application** of systematic approaches to the conduct and management of projects within the technology domain.

3. PROFESSIONAL AND PERSONAL ATTRIBUTES

3.1. **Ethical** conduct and professional accountability.

3.2. **Effective** oral and written communication in professional and lay domains.

3.3. **Creative**, innovative and pro-active demeanour.

3.4. **Professional** use and management of information.

3.5. **Orderly** management of self, and professional conduct.

3.6. **Effective** team membership and team leadership.

Table 1 Knowledge and Skill Base: Elements and Indicators

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT
1.1 Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain.	**a) Engages** with the technology domain at a phenomenological level, applying sciences and engineering fundamentals to systematic investigation, interpretation, analysis and innovative solution of *broadly-defined* problems and engineering technology practice.
1.2 Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the technology domain.	**a) Fluently applies** relevant investigation, analysis, interpretation, assessment, characterisation, prediction, evaluation, modelling, decision making, measurement, evaluation, knowledge management and communication tools and techniques pertinent to the technology domain.
1.3 In-depth understanding of specialist bodies of knowledge within the technology domain.	**a) Proficiently applies** advanced technical knowledge and skills to deliver engineering outcomes in specialist area(s) of the technology domain and associated industry, commercial and community sectors.
1.4 Discernment of knowledge development within the technology domain.	**a) Identifies and critically appraises** current developments and emerging issues professionally disseminated in specialist practice area(s) of the technology domain**.**
1.5 Knowledge of engineering design practice and contextual factors impacting the technology domain.	**a) Identifies and applies** systematic principles of engineering design relevant to the technology domain. **b) Identifies and understands** the interactions between engineering technologies and people in the social, cultural, environmental, commercial, legal and political contexts in which they operate, including both the positive role of engineering in sustainable development and the potentially adverse impacts of engineering activity in the technology domain. **c) Appreciates** the issues associated with international engineering practice activities and global operating contexts. **d) Is aware of** the fundamentals of business and enterprise management. **e) Identifies** the structure, roles and capabilities of the engineering workforce.
1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the technology domain.	**a) Understands** the standards and codes of practice, as well as the legislative and statutory requirements associated with specialist practice area(s) of the technology domain. **b) Appreciates** the principles of safety engineering, risk management and the health and safety responsibilities of the engineering practitioner, applicable to the technology domain. **c) Appreciates** the social, environmental and economic principles of sustainable engineering practice. **d) Understands** the fundamental principles of engineering project management and systems as a basis for planning, organising and managing resources**.**

Notes:

1. *'technology domain' means the specific technological field (eg geotechnics, power systems, manufacturing, etc.) within a branch of engineering (eg civil, electrical, mechanical, etc) or engineering-related discipline.*
2. *'specialist practice area' means the specific area of knowledge and practice within a technology domain, such as slope instability and stabilisation, power systems protection, industrial automation, etc.*

Table 2 Engineering Application Ability: Elements and Indicators

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT
2.1 Application of established engineering methods to broadly-defined problem solving within the technology domain.	**a) Identifies, discerns and characterises** salient issues, **determines and analyses** causes and effects, **justifies and applies** appropriate simplifying assumptions, **predicts** performance and behaviour, **synthesises** solution strategies and **develops** substantiated conclusions. **b) Ensures** that the application of specialist technologies are soundly based on fundamental principles - by diagnosing, and taking appropriate action with data, calculations, results, proposals, processes, practices, and documented information that may be ill-founded, illogical, erroneous, unreliable or unrealistic. **c)** Within specialist practice area(s), **competently addresses** broadly-defined engineering technology problems which involve uncertainty, ambiguity, imprecise information and wide-ranging and sometimes conflicting technical and non-technical factors**.** **d) Recognises** problems which have component elements and/or implications beyond the engineering technologist's personal expertise and **correctly identifies** the need for supplementary professional input. **e) Manages** conflicting issues associated with interfacing, integrating and adapting specialist technologies where complex problems, processes or systems that have been partitioned into manageable elements for the purposes of analysis, modelling, design, prototyping, commissioning or testing, are recombined. **f) Critically evaluates** alternative implementation approaches using specialist engineering technologies and **evaluates** potential outcomes against appropriate criteria to justify an optimal solution choice. **g) Interprets, applies and verifies** compliance with relevant standards and codes of practice as well as legislative and statutory requirements underpinning specialist practice area(s) of the technology domain. **h) Identifies, quantifies, mitigates and manages** technical, health, environmental, safety and other contextual risks associated with engineering application in the technology domain. **i) Accesses** appropriate professional knowledge resources as input to systematic problem investigation.
2.2 Application of engineering techniques, tools and resources within the technology domain.	**a) Proficiently identifies, selects and applies** the materials, components, devices, systems, processes, resources, plant and equipment relevant to the technology domain. **b) Understands** the principles, limitations and accuracy of mathematical, physical or computational modelling. **c) Selects and applies** such models in the representation of phenomenon, processes, systems, components or devices. **d) Determines** properties, performance, safe working limits, failure modes, and other inherent parameters of materials, components and systems relevant to specialist area(s) of the technology domain. **e) Applies** a wide range of engineering tools for analysis, simulation, visualisation, synthesis and design, **assesses** accuracy and limitations of such tools, and validates results. **f) Designs and conducts** experiments, **analyses and interprets** result data and **formulates** reliable conclusions. **g) Analyses** sources of error in applied models and experiments; **eliminates, minimises or compensates** for such errors; **quantifies** significance of errors to any conclusions drawn. **h) Safely applies** laboratory, test and experimental procedures appropriate to the technology domain. **i) Appreciates** the need for systematic approaches to acquisition, commissioning, operation, upgrade, monitoring and maintenance of engineering plant, facilities, equipment and systems. **j) Understands** the role of quality management systems, tools and processes within a culture of continuous improvement.

Table 2 (cont.) Engineering Application Ability: Elements and Indicators

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT
2.3 Application of systematic synthesis and design processes within the technology domain.	**a) Proficiently applies** technological knowledge and problem solving skills as well as established tools and procedures to design components, system elements, plant, facilities and/or processes to meet technical specifications and performance criteria. **b) Accommodates** contextual factors that impact the technology domain, and in particular to ensure that health, safety and sustainability imperatives are addressed as an integral part of the design process. **c) Engages** with a whole systems design cycle, including tasks such as: - determining client requirements and identifying the impact of relevant contextual factors, including business planning and costing targets; - systematically addressing sustainability criteria; - working within projected development, production and implementation constraints; - eliciting, scoping and documenting the required outcomes of the design task and defining acceptance criteria; - identifying assessing and managing technical, health and safety risks integral to the design process; - writing engineering specifications, that fully satisfy the formal requirements; - ensuring compliance with essential engineering standards and codes of practice; - partitioning the design task into appropriate modular, functional elements; that can be separately addressed and subsequently integrated through defined interfaces; - identifying and analysing possible design approaches and justifying an optimal approach; - developing and completing the design using appropriate engineering principles, tools, and processes; - integrating functional elements to form a coherent design solution; - quantifying the materials, components, systems, equipment, facilities, engineering resources and operating arrangements needed for implementation of the solution; - checking the design solution for each element and the integrated system against the engineering specifications; - devising and documenting tests that will verify performance of the elements and the integrated realisation; - prototyping/implementing the design solution and verifying performance against specification; - documenting, commissioning and reporting the design outcome. **d) Is aware of** the accountabilities of the members of the engineering team in relation to the 'design authority' role.
2.4 Application of systematic approaches to the conduct and management of projects within the technology domain.	**a) Contributes to and/or manages** *broadly-defined* technological project activity, as a member of the engineering team and/or as leader of a specialist technological team. **b) Seeks out** the requirements and associated resources and **realistically assesses** the scope, dimensions, scale of effort and indicative costs of a broadly-defined technological project. **c) Accommodates** relevant contextual issues into all phases of project work, including the fundamentals of business planning and financial management. **d) Proficiently applies** basic systems engineering and/or project management tools and processes to the planning and execution of project work, targeting the delivery of a significant outcome to a professional standard. **e) Is aware of** the need to plan and quantify performance over the full life-cycle of a project, managing performance outcomes within the overall implementation context. **f) Demonstrates** commitment to sustainable engineering practices and the achievement of sustainable outcomes in all facets of technological project work.

Table 3 Professional and Personal Attributes: Elements and Indicators

ELEMENT OF COMPETENCY	INDICATORS OF ATTAINMENT
3.1 Ethical conduct and professional accountability.	**a) Demonstrates commitment** to uphold the Engineers Australia - Code of Ethics, and established norms of professional conduct pertinent to the technology domain. **b) Understands** the need for 'due-diligence' in certification, compliance and risk management processes. **c) Understands** the accountabilities of the engineering technologist and the broader engineering team for the safety of other people and for protection of the environment. **d) Is aware of** the fundamental principles of intellectual property rights and protection.
3.2 Effective oral and written communication in professional and lay domains.	**a) Is proficient in** listening, speaking, reading and writing English, including: - comprehending critically and fairly the viewpoints of others; - expressing information effectively and succinctly, issuing instruction, engaging in discussion, presenting arguments and justification, debating and negotiating - to technical and non-technical audiences and using textual, diagrammatic, pictorial and graphical media best suited to the context; - representing an engineering technology position to professional colleagues, or to the broader community; - appreciating the impact of body language, personal behaviour and other non-verbal communication processes, as well as the fundamentals of human social behaviour and their cross-cultural differences. **b) Prepares** high quality engineering documents such as progress and project reports, reports of investigations and feasibility studies, proposals, specifications, design records, drawings, technical descriptions and presentations pertinent to the technology domain.
3.3 Creative, innovative and pro-active demeanour.	**a) Applies** creative approaches to identify and develop alternative concepts, solutions and procedures, appropriately challenges engineering practices from technical and non-technical viewpoints; identifies new technological opportunities. **b) Seeks out** new developments in specialist area(s) of the technology domain and **applies** fundamental knowledge and systematic processes to evaluate and report potential. **c) Is aware of** broader fields of technology, science, engineering and commerce from which new ideas and interfaces may be drawn and readily **engages** with professionals from these fields to exchange ideas.
3.4 Professional use and management of information.	**a) Is proficient in** locating and utilising information - including accessing, systematically searching, analysing, evaluating and referencing relevant published materials and data. **b) Critically assesses** the accuracy, reliability and authenticity of information. **c) Is aware of** common document identification, tracking and control procedures.
3.5 Orderly management of self, and professional conduct.	**a) Demonstrates commitment** to critical self-review and performance evaluation against appropriate criteria as a primary means of tracking personal development needs and achievements. **b) Understands** the importance of being a member of a professional and intellectual community, learning from its knowledge and standards, and contributing to their maintenance and advancement. **c) Demonstrates** commitment to life-long learning and professional development. **d) Manages** time and processes effectively, prioritises competing demands to achieve personal, career and organisational goals and objectives. **e) Thinks critically** and applies an appropriate balance of logic and intellectual criteria to analysis, judgement and decision making. **f) Presents** a professional image in all circumstances, including relations with clients, stakeholders, as well as with professional and technical colleagues across wide ranging disciplines.
3.6 Effective team membership and team leadership.	**a) Understands** the fundamentals of team dynamics and leadership. **b) Functions as** an effective member or leader of diverse engineering teams, including those with multi-level, multi-disciplinary and multi-cultural dimensions. **c) Earns** the trust and confidence of colleagues through competent and timely completion of tasks. **d) Recognises** the value of alternative and diverse viewpoints, scholarly advice and the importance of professional networking. **e) Confidently pursues and discerns** expert assistance and professional advice. **f) Takes initiative and fulfils** the leadership role whilst respecting the agreed roles of others.