



ECSA

ENGINEERING COUNCIL OF SOUTH AFRICA

An Effective Regulator Assuring Engineering Excellence

**Discipline-specific Training Guide for Registration as a
Professional Engineer, Technologist, and Technician in
Computer Engineering**


R-05-COMP-PE/PT/PN

REVISION 0: 19 September 2025

ENGINEERING COUNCIL OF SOUTH AFRICA

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INTRODUCTION

All persons applying for registration as a Professional Engineer, Technologist or Technician are expected to demonstrate the competencies specified in document **R-02-STA-PE/PT/PN** through work performed at the prescribed level of responsibility, irrespective of the Applicant's/ Candidate's discipline.


The *Training and Mentoring Guide for Professional Categories (R-04-T&M-GUIDE-PC)* provides key aspects of training. These are as follows:

- Duration of training and length of time working at level required for registration.
- Principles of planning, training and experience.
- Progression of training programme.
- Documenting training and experience.
- Demonstrating responsibility.

It is therefore important to standardise the framework for all engineering disciplines to ensure that all ECSA registration categories are aligned.

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DEFINITIONS

Applicant means a person applying to ECSA for registration in any of the categories according to Section 18 of the Engineering Profession Act, 46 of 2000.

Broadly defined engineering problems are composed of many interrelated conditions and require underpinning methods, procedures and technical judgement to create a solution within a set of originally broadly defined circumstances.

Broadly defined engineering work is characterised by the following:

- It is constrained by available technology, time, finance, infrastructure, resources, facilities, applicable laws, standards and codes.
- It involves a variety of resources, including people, money, equipment, materials and technologies.
- It requires the resolution of occasional problems arising from interactions among wide-ranging or conflicting issues such as technical and engineering issues.
- It has significant risks and consequences in the practice area and related areas.
- The practice area is located within a wider, complex context; it requires teamwork and has interfaces with other parties and disciplines.
- The scope of the practice area is linked to the technologies used and the changes due to the adoption of new technology into current practice.

Candidate means a person registered with ECSA in a candidate category of registration.


Complex engineering problems involve multiple factors, uncertainties, interdependencies and constraints, making them difficult to define, analyse and solve.

Complex engineering work is characterised by the following:

- Scope of activities may encompass entire complex engineering systems or complex subsystems.
- A context that is complex and varying is multidisciplinary, requires teamwork, is unpredictable and may need to be identified.
- It requires diverse and significant resources including people, money, equipment, materials and technologies.

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- Significant interactions exist among wide-ranging or conflicting technical, engineering or other issues.
- It is constrained by time, finance, infrastructure, resources, facilities, standards and codes, and applicable laws.
- It has significant risks and consequences in a range of contexts.

Competency standard means a statement of competency required for a defined purpose.

Engineering problem means a problem that requires the application of engineering theories, principles, knowledge and skills to find a solution. These problems typically arise in various fields of engineering. Engineering problems can range from designing and building structures, developing new technologies or products, optimising processes and/or systems, improving efficiency, solving complex mathematical equations, troubleshooting technical issues and addressing safety concerns, among many others. The goal of solving an engineering problem is to create innovative and practical solutions that meet specific requirements, adhere to applicable regulations and standards and utilise techniques such as cost benefit analysis, risk analysis and technical evaluations to arrive at a cost-effective and sustainable solution.


Engineering science means a branch of science that applies scientific principles and methods to solve engineering problems. It involves the study and application of various scientific disciplines, such as physics, chemistry, mathematics and materials science, to design and develop innovative solutions to address engineering problems. Engineering science focuses on understanding the fundamental principles underlying engineering systems and processes, and uses this knowledge to analyse, predict and optimise the behaviour and performance of engineering systems. It provides the theoretical foundation for various engineering disciplines and plays a crucial role in advancing technology and driving innovation in engineering

Ill-posed problem means a problem in which the requirements are not fully defined or may be defined erroneously by the requesting party.

Integrated performance refers to the evaluation and optimisation of various aspects of a system or product to ensure its overall efficiency, effectiveness and reliability. It involves considering multiple performance factors, such as functionality, safety, durability, maintainability, cost-effectiveness and environmental impact, and integrating them into a cohesive design. It considers the interactions and trade-offs among different components,

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subsystems and functions within a system. It aims to achieve a balance between conflicting requirements and constraints to create a well-rounded and high-performing solution. This holistic approach helps ensure all aspects of the design work together harmoniously, resulting in a successful and optimised engineering solution.


Level descriptor means a measure of performance demands at which outcomes must be demonstrated.

Management of engineering works or activities refers to the process of planning, organising, coordinating and controlling various engineering projects or tasks. It involves overseeing the activities of engineers and other personnel involved in the design, development, construction and maintenance of engineering projects for the successful execution of engineering projects, ensuring that they are completed on time, within budget and to the desired quality standards.

Key responsibilities of engineering management may include the following:

- **Planning:** Defining project objectives, scope and deliverables, and creating a detailed plan to achieve them.
- **Resource management:** Determining the required resources, such as personnel, equipment and materials, and allocating them appropriately to ensure smooth execution of engineering work.
- **Team coordination:** Managing and leading a team involved in the activities of performing engineering work and ensuring effective communication, collaboration and coordination among team members.
- **Risk management:** Identifying potential risks and developing strategies to mitigate them.
- **Quality control:** Implementing quality assurance processes to ensure that engineering works meet the required standards and specifications.
- **Budget and cost control:** Monitoring project expenses, tracking costs and ensuring that projects are completed within the allocated budget.
- **Stakeholder management:** Engaging with clients, contractors, suppliers and other stakeholders to address their concerns, manage expectations and maintain positive relationships.

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- **Executing engineering work:** Direct and control engineering processes and systems, including commissioning, operating and decommissioning equipment, while maintaining safety at all times, and ensuring timeous completion.

Mentor means a professionally registered person who guides the competency development of a Candidate in an appropriate category.

Outcome at the professional level means a statement regarding the performance that a person must demonstrate to be judged competent.

OPC Unified Architecture (OPC UA) is a machine-to-machine communication protocol for industrial automation developed by the OPC Foundation.

Over-determined problem means a problem whose requirements are defined in excessive detail, making the required solution impossible to attain in all its aspects.

Practice area means a generally recognised or distinctive area of knowledge and expertise developed by an engineering practitioner through following the path of education, training and experience.

Range statement means the required extent or limitations of expected performance stated in terms of situations and circumstances in which outcomes are to be demonstrated.


Specified category means a category of registration for persons who are licensed through the Engineering Profession Act, 46 of 2000 or a combination of external legislation and the Engineering Profession Act, who have specific engineering competencies at the level of NQF5 that are associated with an identified need to protect the public safety, health and interest or the environment in relation to an engineering activity.

Supervisor means a person who oversees and controls engineering work performed by a Candidate.

Well-defined engineering problems are composed of interrelated conditions and requiring underpinning methods, procedures and techniques to create a solution within a set of originally well-defined circumstances.

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ABBREVIATIONS

B Eng	Bachelor of Engineering
BDEA	Broadly Defined Engineering Activities
BSc Eng	Bachelor of Science in Engineering
B Tech (Eng)	Bachelor of Technology in Engineering
B Eng (Tech)	Bachelor of Engineering in Technology
CAD	Computer-aided Design
CPD	Continuing Professional Development
C&U	Commitment and Undertaking
DCS	Distributed Control System.
DSTG	Discipline-specific Training Guide
ECSA	Engineering Council of South Africa
FA	Factory Automation
PA	Process Automation
MD	Mechatronics Devices
HMI	Human–Machine Interface
IPD	Initial Professional Development
ICASA	Independent Communications Authority of South Africa
ICT	Information Computer Technology
IEA	International Engineering Alliance
JBCC	Joint Building Contract Committee
MEng	Master of Engineering
NDip	National Diploma

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NEC	New Engineering Contract
NRS	National Rationalised Specifications
PC	Personal computer.
PGDip	Postgraduate Diploma
PLC	Programmable Logic Controller.
SABS	South African Bureau of Standards
SANS	South African National Standard
SBC	Single Board Computer.
SCADA	Supervisory Control and Data Acquisition Control System.
TERs	Training and Experience Reports
TES	Training and Experience Summary
VA	Voluntary Association
VIP	Value Improved Practice

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1. PURPOSE OF THE DOCUMENT

All persons applying for registration as Engineering Professionals are expected to demonstrate the competencies specified in document **R-02-STA-PE/PT/PN** through work performed at the prescribed level of responsibility, irrespective of the discipline.

This document supplements the generic *Training and Mentoring* Guide for professional categories (**R-04-T&M-GUIDE-PC**) and the *Guide to the Competency Standards for Registration in Professional Categories* (**R-08_CS-GUIDE-PE/PT/PN**) for Applicant Computer Engineers, Technologists and Technicians or any other person who intends to register as a Professional with ECSA in the respective discipline.

This document must be read in conjunction with the following documents:

- Policy on Registration in Professional Categories (**R-01-POL-PC**)
- Processing of Applicants for Registration of Applicants and Professionals (**R-03-PRO-PC**)
- Training and Mentoring Guide for Professional Categories (**R-04-TM-GUIDE-PC**).

2. AUDIENCE


This Discipline-specific Training Guide (DSTG) provides guidance and support to those interested in applying for registration to become professionals through ECSA in the field of Computer Engineering. Additionally, supervisors and mentors of these aspiring Applicants can also benefit from this guide, as it offers best practices and elements necessary for a comprehensive training and experience programme.

This guide applies to persons who:

- are registered as a Candidate Engineer, Technologist, or Technician and/or embarked on a process of training under a registered Mentor guiding the professional development process at each stage
- are not registered as a Candidate, but deem it fit based on experience specified in this document to apply to become a professional

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- hold an ECSA-accredited qualification or an acceptable combination of accredited qualifications prescribed for the category
- have met the minimum education in a specific category through ECSA educational qualification evaluation or assessment
- have qualifications recognised by the Washington, Sydney and Dublin Accords for which the ECSA is a signatory thereof
- hold a qualification or combination of qualifications recognised under an international academic agreement relevant to the category, or
- hold a qualification or a combination of qualifications that has been determined on a case-by-case evaluation to satisfy criteria for substantial equivalence to an accredited qualification for the category by virtue of:
 - the qualifications being awarded in a jurisdiction or a quality assurance system by ECSA, or
 - examination of detailed documentation on the qualifications reflecting substantial equivalence.


2.1 Persons registered as a candidate with ECSA

Candidate engineering practitioners refer to persons registered with the ECSA after completing the relevant engineering undergraduate programme as accredited or substantially assessed to be equivalent by ECSA. Training and development can be done under a Commitment and Undertaking (C&U) candidacy programme according to document **R-11-PRO-PC** or through a training academy's programme as outlined in document **A-01-POL**.

The training under a C&U or through a training academy is structured to align with the ECSA standard competency outcomes for the benefit of the Candidate. The professional Mentor, Supervisor, Coach and the Candidate must ensure that the training covers all developmental aspects aligned with the competency outcomes required for registration as a professional. Mature Applicants for registration may apply the guide retrospectively to identify possible gaps in their development.

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2.2 Persons not registered as a Candidate with ECSA

Individuals who meet the qualifications and competence requirements outlined in document **R-02-STA-PE/PT/PN** can apply for professional registration without going through the Candidate route. However, it is still essential for these individuals to have mentorship and supervision to ensure effective development towards meeting the competency requirements for professional registration. If the employer does not offer C&U, the aspiring Applicant should seek mentorship. If no internal Mentor is available, an external Mentor can be sought. The individual can consult the Voluntary Association (VA) for the discipline to assist in locating an external Mentor. The Mentor should stay updated on the development process and the ECSA registration requirements.

This document is intended for Applicants/Candidates undergoing training and gaining experience in preparation for registration. Applicants who have not had mentorship are advised to seek the guidance of an experienced Mentor (internal or external) when preparing their registration applications.

Document **R-08-CS-GUIDE-PE/PT/PN** guides individuals with unconventional developmental paths, such as academics, researchers and specialists.


3. TYPE OF ENGINEERING WORK

Computer Engineering practitioners form a collective group of engineers who design, advise, plan, direct, implement, test, maintain and conduct research on computer hardware and software for computer-based systems in electronic, electrical, telecommunications, information technology and other allied fields. Computer Engineers use computer science and electronic engineering knowledge to develop system software and hardware for control, management, performance aiding, monitoring of computing systems, products, components and processes.

Computer Engineering practitioners' functions include research, planning, design, development, construction, operation and maintenance of software and firmware for software computing systems, hardware computing systems, embedded microcontrollers, operating systems, data security systems, imaging systems, robotic systems, information technology

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systems and artificial intelligence systems, among others. They are also able to perform disaster recovery operations and to ensure the protection of data from malicious cyber-attacks.

They have a strong understanding of software architecture, software applications, databases, communication infrastructure, communication protocols, computer hardware and artificial intelligence tools. They also have superior fault-finding skills in hardware and software functions. They have to be scientifically knowledgeable on the algorithms and statistical models that computer systems use to effectively and independently execute a targeted task.

Some of the specialisation areas may be defined as:


- Computer Engineering
- System Engineering
- Software Engineering
- Data Security Engineering
- Electronic Engineering
- Computer Hardware Engineering
- Telecommunication Engineering
- Network Engineering
- Embedded Systems Engineering
- Artificial Intelligence
- Computer Engineering Vision
- Big Data Engineering.

The Computer Engineering field includes any industry or industry sector where the engineering work, as defined, includes among others, the following:

- The development of any system processing and/or storing confidential or restricted data.
- The development of any system essential for the continuous safe operation of people, processes or devices.
- The development of any system essential for the continuous safe manufacture or processing of physical products, including but not limited to electricity, oil, gas, minerals,

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metals, food, beverages, medical equipment and devices, fast-moving consumer goods, clothing, furniture and automobiles, among others.


- The development of any system providing a critical or campus-wide service.
- The development of any system to monitor, detect and react to adverse events before they escalate.
- The development of any system to guide processes that may alter production or financial outcomes.
- The development of any system to monitor, detect and record incidents that will have consequences for the health and safety of product, people or the environment.

A Computer Engineer may undertake tasks to solve engineering problems, which may include:

- conducting research and developing new or improved theories and methods relating to Computer Systems Engineering
- advising on and designing hardware-based and software-based computer systems or components, systems equipment, network and communication equipment, software and distribution centres
- specifying production or installation methods, specifying materials, quality and safety standards and directing production and installation of computer-based products, software and systems
- supervising, controlling, developing and monitoring the operation and maintenance of computer-based systems, software, networks and equipment
- developing and implementing test procedures for computer-based systems, software, networks, programmes and equipment
- establishing control standards and procedures to ensure efficient functioning and safety of computer-based systems, software, networks and equipment
- organising and directing the maintenance and repair of existing computer-based systems, programs and equipment
- researching and advising on computer-based equipment and software
- designing computer-based systems, software, networks, programs and equipment
- determining computer manufacturing methods for computer-based equipment and maintaining and repairing existing computer-based equipment

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- planning and designing computer-based communication networks based on radar, telemetry and remote-control systems, microwaves, wired, fibre optic and wireless communication media, ultra-high-speed data networks and other electronic equipment
- planning and designing computer-based telecommunication networks and radio and television distribution systems, including cable transmission and over-the-air broadcasting
- designing and developing signal processing algorithms and implementing these through appropriate choice of hardware and software
- implementing these computer-based systems through appropriate choice of hardware and managing the development of the necessary software
- designing, specifying and implementing Control and Instrumentation of plants and processes
- designing, specifying, controlling and monitoring of equipment for fire detection and safety (safety integrity level – SIL rating) in plants and factories
- controlling robotics and processes of manufacturing plants
- performing system analyses together with designing and developing computer-based systems
- developing procedures to test data security software and software components
- investigating, responding and collaborating on any security breach within networks and systems
- conducting numerous tests on system vulnerability to evaluate stability as well as troubleshooting of incidents
- managing all communication between departments to ensure security functionality.

Practising Computer Engineering practitioners may specialise in one or more of the following fields: Computer System Design, Systems, Software, Systems Architecture, Additive and Subtractive Manufacturing, Energy Efficiency and Renewable Systems, Communications, Mechatronics, Electronic Design, Instrumentation, Television, Biomedical Equipment, Clinical, Aircraft Electronic Systems, Electronic Warfare, Robotics – kinematics, electronic sensors, software integration, Data Acquisition, Logging and Recording, Sensors, Transducers and Measurement Systems Instrumentation Engineer, Safety Systems, Single Board Computer

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Design, Circuit Design, Power Electronics and Drives (motors, drives, power supplies), Control Philosophies, Automation Safety and Best Practices, Vision Systems, Broadcasting, Digital Signal Processing, Communications, Fibre Optics, Radio Frequency Design, Radar Systems, Radio Systems, Radio and Telecommunications, Telemetry and IIOT devices, Mobile Radio, Satellite Transmission, Processing and Communications Systems, Specialist Telecommunications (ICT), Consulting Telecommunications, Network Planning, Microwave Systems, Software Programming (Programming, Applications and Database), Data Management and Database Administration, Software Design, Process Modelling, Enterprise Resource Planning, Materials Requirements Planning, Product Lifecycle Management, Supply Chain Management, Advanced Planning and Scheduling, Advanced Visioning and Diagnostic Systems, Industrial Software Engineer, Digital Twins, Workflow Systems, Biometrics Systems, Industrial Internet of Things and Cloud Systems, Smart Factory Engineering, Autonomous Processes, Systems and Operations, Front-end Software Engineering, Back-end Software Engineering, Systems Engineering, Solutions Architecting, Computer Systems Design, Integrated Circuit Design, Microelectronic Design, Network Security, Wide Area and Local Area Network Topology Design, Industrial Network Topology Design, Data Security, Web Security, Cyber Security, Embedded Hardware and Software, Electronic Design, Embedded Controllers (Including Microcontrollers), Augmented Reality, Artificial Intelligence, Machine Learning, Data Science, Data Modelling, Predictive Control, Predictive Maintenance, Process Optimisation, Numerical Analysis Methods,

4. DEVELOPING ENGINEERING COMPETENCIES: DOCUMENT (R-08-PE/PT/PN)


4.1 Training for registration as a Professional Engineer

4.1.1 Outcome 1: Define, investigate and analyse complex engineering problems (Responsibility level E)

This outcome requires the engineers to be able to define, investigate and analyse complex engineering problems by identifying systems and subsystems in resolving complex problems, using data and information technologies where applicable. The complex engineering problem

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may be defined as a design requirement, an applied research and development requirement or a problematic situation in an existing component, system or process.

The investigation and analysis require in-depth fundamental and specialised engineering knowledge, including the collection, organising and evaluation of the information from all applicable sources, including investigation where appropriate. The work typically includes the research, planning, design, manufacturing, commissioning and installation of computer-based systems that often span hardware, embedded software, communication protocols and distributed architectures.

The Applicant should develop the ability of:


- defining the engineering problems and procedures for solving the problems
- investigating and evaluating pertinent information and identifying systems and subsystems of complex problems including collecting, organising and evaluating information from all applicable sources including in-situ investigations where appropriate
- analysing relevant assumptions, inputs and required outputs of a complex engineering problem.

The Applicant should be able to perform the following activities, among others:

- Provide a clear definition, understanding, identification and framing of the characteristics of a complex problem: multiple subsystems, uncertainty, time constraints or interoperability challenges.
- Provide investigations of computing systems. This could be using system logs, trace data, sensor outputs, user interaction feedback or runtime metrics; system crashes in an embedded application due to conflicts between hardware interrupt timing and network stack execution; failure in a distributed control system where software on different nodes fails to synchronise; or investigating accuracy, bias or integration failures in AI/ML systems, particularly where model performance degrades in production due to poor data pre-processing, model drift or system mismatches between training and deployment environments.
- Provide performance analysis of computing systems. This could be root cause analysis of security breaches due to misconfigured authentication in a cloud-connected device;

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interactions among hardware, firmware, software and communication layers to identify failure points; or real-time system delays in a multi-threaded embedded application.

- Provide failure analysis in computing systems. This could be using various communication protocols, such as industrial protocols like OPC UA, Modbus or CAN, IoT/Automation protocols like MQTT, or standard network protocols like TCP/IP and UDP, etc.
- Provide system diagnostic with discipline-specific tools. This could be using packet sniffers (e.g., Wireshark), protocol analysers, logic analysers or embedded debuggers to gather and interpret system data. Diagnosing intermittent data loss or synchronisation issues in a control system using OPC UA over TCP/IP in a noisy or high-latency environment.
- Provide troubleshooting diagnostics for computing systems. This could be packet loss in a video streaming or sensor system using UDP and deter computer buffer sizing or timing issues.
- Provide debugging reports on computing systems. This could be resource management issues in long-running applications (e.g., MES, backend servers, AI inference services), including memory leaks, CPU spikes or I/O blocking, or identifying the root cause at the code or infrastructure level.
- Attend training and acquire competencies in the above aspects of a computing system.


4.1.2 Outcome 2: Design or develop solutions to complex engineering problems (Responsibility levels C and D)

This outcome requires the engineers to be able to undertake an engineering design of the solution to a complex engineering problem that includes having detailed requirements or specification that aligns with the required design and having potential solutions or methods that can be used to approach and resolve the complex problem. The preferred option or way forward is influenced by factors that best fit the solution, taking into consideration cost, practicability, innovation and any impact outside the requirements. The solution is amenable to widely applied principles, has sound and testable assumptions and is underpinned by the utilisation of requisite advanced principles relevant to the problem, being cognisant of impacts and the need for sustainability.

This competency focuses on the ability to design or develop effective and practical solutions to engineering problems that are complex in nature. These problems often span hardware,

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software, communication protocols and integration layers. Trainees should demonstrate not only technical knowledge but also the ability to consider constraints, trade-offs, standards and the end-user or system context. The solution process includes defining requirements, evaluating alternatives, selecting appropriate technologies, applying sound design principles, and implementing or prototyping the solution in a way that is verifiable and fit for purpose.

The Applicant should develop the ability to:

- design or develop solutions to complex engineering problems using appropriate theory and information technology while checking impacts, sustainability and stakeholder views
- systematically synthesise solutions and provide alternatives by making use of first or fundamental principles within unfamiliar or previously encountered techniques and testing the validity and reasonability of assumptions, correlating with requirements and considering the far-reaching impacts and costs
- evaluate the final solution and develop documentation and an integrated implementation plan.

The Applicant should be able to perform the following activities, among others:


- Provide designs and solutions for computing systems that feature the following: translation of problem definitions into functional and non-functional system requirements; selection of appropriate technologies (e.g., microcontrollers, protocols, platforms, frameworks) based on technical and business constraints; consideration of design trade-offs among performance, cost, safety, reliability, complexity, scalability, power consumption and maintainability; or integrating hardware and software components into a cohesive system with clear interfaces and testability.

This may include the following:

- Developing a modular software system for an MES platform using microservices or layered architecture to support scalability and maintainability.
- Designing a secure and scalable IoT gateway using MQTT and TLS to collect, process and forward sensor data to a cloud platform.

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- Designing a low-latency, high-availability server application for handling OPC UA-based telemetry in a process control system.
- Architecting a hybrid edge/cloud computing solution to deploy and manage ML models in a factory environment.
- Designing a system where safety and redundancy requirements must be met (e.g., medical devices, robotics or automotive control units).
- Developing a power-efficient sensor node that balances processing needs, wireless communication, and energy harvesting or battery constraints.
- Designing a fault-tolerant distributed software system that uses consensus algorithms or retry logic for robustness under network failure.
- Providing design and their solution for computing systems that applies industry-relevant design methodologies such as, object-oriented design for software systems, layered architecture or microservices for distributed systems and real-time design patterns in embedded or time-critical systems.
- Providing designs and solutions for computing systems that incorporate relevant standards, protocols, and best practices e.g., OPC UA, MQTT, ISO/IEC 12207 for software lifecycle, security practices, ISA-95 for Enterprise-Control Systems Integration, ISA-88 for Batch Control, ISA-106 Procedure Automation for Continuous Process Operations, ISA/IEC-62443 for Security for IAC Systems, Good Automated Manufacturing Practice (GAMP).
- Developing design documentation with design decisions, assumptions and rationale in a structured and traceable way.
- Developing design prototype and implementations and validating design choices using simulations, emulators, breadboards, test harnesses or test environments. This may include creating an embedded system for industrial automation, balancing real-time constraints, hardware limitations and fieldbus protocol integration (e.g., CAN or Modbus) or implementing and testing a custom communication protocol for high-throughput data acquisition in a smart manufacturing setup.
- Attending training and acquiring competencies in the above aspects of a computing system.

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4.1.3 Outcome 3: Comprehend and apply advanced and local knowledge of the widely applied principles underpinning good practice that is specific to the jurisdiction in which the Engineer practises (Responsibility level E)

This outcome requires the Engineers to be able to comprehend and apply advanced and local knowledge of the widely applied principles underpinning good practice that is specific to the jurisdiction in which the Engineer practises. Applicant Engineers should be able to provide evidence that they have comprehended and have mastered the engineering principles and technologies for their practice areas and that they apply first-principle, analytical thinking in demonstrating this competency for the associated complex programme. This includes the application of fundamental principles, practices, sound testable assumptions or previously encountered techniques that the Applicant has used to solve the complex problem. Applicants require In-depth specialist knowledge in the practice area that supports a fundamentals-based, first-principles, analytical approach. This is supplemented by legal, regulatory and locally relevant knowledge.


The theoretical knowledge gained from completing a BEng/BSc degree should also be applied in addition to knowledge of applicable engineering standards, codes of practice, legislation and regulations. This competency is about recognising that engineering problems and solutions do not exist in isolation; they are influenced by the broader context in which they operate. Trainees must demonstrate the ability to understand and apply knowledge of external factors such as industry domain and social, economic, environmental, regulatory and technological context to inform decisions and develop appropriate solutions.

The Applicant should develop the ability to:

- state what fundamental engineering principles, practices, sound testable assumptions or previously encountered techniques, including the application of NQF 8 theory, are applied in the practice area
- indicate a working knowledge of interacting disciplines (engineering and other) to underpin teamwork
- demonstrate knowledge and application of engineering standards, codes of practice, legislation, regulations and finance in the practice area.

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The Applicant should be able to perform the following activities among others:

- Provide design solution based on discipline specific knowledge from first principles. This should display mastery in the understanding of engineering principles, practices and technologies in the practice area.
- Provide system analysis of engineering problems by applying general and underpinning engineering knowledge to support analysis and provide insight.
- Develop engineering models using an analytical approach based on fundamentals and first principles as required.
- Display working knowledge of areas that interact with the practice area.
- Apply related financial, statutory, safety and management knowledge in practice.
- Calculate at theoretical level confirming the correct application and utilisation of equipment, materials and systems.
- Display understanding of complex procedures and techniques that must be based on fundamental mathematical, scientific and engineering knowledge, as part of personal contribution within the engineering team.
- Display the ability to manage the resources within legal and financial constraints.
- Attend theoretical and practical training and acquire competencies in the above aspects of a computing system.


4.1.4 Outcome 4: Manage part or all of one or more complex engineering activities (Responsibility level D)

This outcome requires the Engineers to be able to manage part or all of one or more complex engineering activities. Management of complex engineering activities is directed at achieving results as a member or leader of a team by planning and harnessing people, resources, processes, systems, money and contracts or agreements.

This competency relates to the ability to plan, organise, lead and monitor engineering tasks either individually or within a team context. It includes managing time, resources, technical risks and interfaces between tasks or subsystems. In Computer Engineering, this could involve managing software development lifecycles, coordinating embedded systems integration or leading the deployment of complex distributed systems. Trainees must demonstrate the ability

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to work systematically, follow processes and take responsibility for deliverables, ensuring that engineering work is completed effectively and efficiently within given constraints.

The Applicant should develop the following abilities:


- Manage self, people, work priorities, processes and resources when performing complex engineering activities.
- Plan, organise, lead and control complex engineering activities.
- Manage contracts and other agreements and establish and maintain professional and business relationships.

The Applicant should be able to perform the following activities, among others:

- Provide engineering plans, coordination and oversee engineering projects to ensure they are completed on time, within budget, meet project milestones and to the required quality standards. This may include planning and executing the deployment of an ERP or MES system upgrade across multiple production sites with minimal downtime or coordinating embedded software development in parallel with hardware prototyping, ensuring interface alignment and integration testing.
- Define the project objectives, organise resources, schedule activities, manage risks and communicate with stakeholders.
- Understand and manage stakeholder expectations, project scope and client communication.
- Provide leadership in managing self, people, work priorities, processes and resources when performing complex engineering activities. This may include leading a small team in implementing a machine-learning model deployment pipeline, from data collection to live inference on edge devices.
- Provide contract management and other agreements and the ability to establish and maintain professional and business relationships.
- Ensure documentation, testing and version control are integrated into the workflow. This may include managing documentation, version control (e.g., Git) and automated testing in a software development project to maintain traceability and quality or ensuring

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coordination across disciplines, e.g., hardware, software, networking, security and production teams.


- Provide resources management and availability, controlled by a work breakdown structure and scheduling to meet deadlines. This should consider team skills, tools, system constraints, quality, safety and environment management.
- Apply the basic elements of management to complex engineering work. This should involve the application of engineering management methodologies such as Agile or Scrum (for software projects), V-model or Waterfall (for embedded or safety-critical systems), DevOps or CI/CD pipelines (for cloud or application deployments). This may include managing the development lifecycle of a custom IoT solution, including firmware, communication protocol integration and cloud platform deployment, using Agile project methods.
- Provide project progress monitoring using tools such as RAID (Risks, Actions, Issues and Decisions or Dependencies) logs to identify bottlenecks, issues or risks, and take corrective actions as needed. This may include handling risk and scope changes during a distributed system migration, ensuring rollback plans and performance benchmarks are in place.

The training elements of a training scheme (see **Appendix A**) indicate the functions in which an Applicant should be competent when carrying out the various phases of a project. The functions include:

- solving problems based on engineering and contextual knowledge
- implementing and operating engineering projects, systems, products and processes
- mitigating risk and impact
- managing engineering activities.

These functions are aligned with the overall competency of the outcomes expected from the Applicants. In addition, Applicants must state the requirement of the project in terms of delivery, refer to the initial production requirements for the project and state whether they obtained results, and if not, why they were unsuccessful.

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4.1.5 Outcome 5: Communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of engineering activities
(Responsibility level C)

This outcome requires Engineers to communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of their complex engineering activities. They should communicate effectively both orally and in writing, with engineering audiences and the community at large and convey technical information through written reports, presentations and technical documentation, as well as collaborating with team members, clients and other stakeholders in their complex engineering activities.

Applicants should develop the ability to:


- write clear, concise, effective and technically, legally and editorially correct reports using a structure and a style that meet communication objectives and user/audience requirements.
- issue clear and concise instructions and/or guidance, being cognisant of the audience and various skill levels
- deliver structured oral presentations using appropriate language, visual aids and supporting materials for the intended audience and purpose.

The Applicant should be able to perform the following activities, among others:

- Provide clear instructions to audiences using suitable language and communication tools, ensuring that any language or communication barriers are addressed.
- Deliver professional oral presentations on complex topics, using technical media (e.g., slides, diagrams, appendices) for both short and extended formats.
- Produce high-quality technical documentation or simulated academic materials relevant to the engineering context.
- Produce professional written reports using technical means and software, ranging from short to long containing words, tables, diagrams and appendices while covering material at exit-level.
- Provide technical information using conventional methods of the discipline, for example engineering drawings and subject-specific methods.

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- Engage in effective interpersonal communication with team members and clients at meetings and in professional and non-professional networks.
- Communicate effectively in contexts such as project management, public speaking, regulatory compliance or legal environments to support informed decision-making and problem-solving.

4.1.6 Outcome 6: Recognise the reasonably foreseeable economic, social, cultural and environmental effects of complex engineering activities seeking to achieve sustainability (Responsibility level B)

This outcome requires the Engineers to recognise the reasonably foreseeable economic, social, cultural and environmental effects of complex engineering activities seeking to achieve sustainability. The outcome requires the Applicants to recognise and address the impact of their complex engineering activities on these components and where there are negative effects, to provide mitigating measures.


Risk and impact mitigation must include the probability and impact of all the risks connected with the project. Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs, and press releases.

The Applicant should develop the ability to:

- identify interested and affected parties and their expectations with regard to technical, sociocultural and environmental effects, while considering the economics and long-term sustainability of the complex engineering activities
- recognise and address the impact of their complex engineering activities on social, cultural and environmental components
- identify the risk of negative impact of the complex engineering activities on the components and develop plans and measures to mitigate the negative effects of complex engineering activities.
- integrate sustainability and ethics into the decision-making process throughout the project lifecycle.

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The Applicant should be able to perform the following activities, among others:

- Provide a clear study, analysis and recommendations for the following: social/cultural impacts, community/political considerations, environmental impact, sustainability analysis, regulatory conditions and potential ethical dilemmas.
- Provide a risk documentation through the life cycle of the project that should include technical risk, environmental risk, quality risk, commercial risk, schedule risk, social risk, cultural risk and construction risk.

4.1.7 Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons during all complex engineering activities (Responsibility level E)


This outcome requires the engineers to develop a working knowledge of the related regulations and Acts and to be able to demonstrate how this legislation affects their complex engineering activities. They are required to meet all legal and regulatory requirements and protect the health and safety of persons during all complex engineering activities.

All engineering work must be carried out in accordance with the norms of the profession. Such norms are generally represented by national and international standards, industry standards, codes of practice and best practice guidelines. Candidates are expected to have a basic knowledge of the applicable Acts that are applicable to their area of practice. The list of common Acts and regulatory standards, among others, in the Computer Engineering profession is below.

- Engineering Profession Act, 46 of 2000
- Occupational Health and Safety Act, 85 of 1993
- National Building Regulations and Building Standards Act, 103 of 1977
- National Environmental Management Act, 107 of 1998
- Employment Equity Act, 55 of 1998
- Mine Health and Safety Act, 29 of 1996
- Occupational Health and Safety Act, 85 of 1993 and Regulations
- Specific work instructions, standards, and/or specifications of the enterprise
- Protection of Personal Information Act, 4 of 2013

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- Specific work instructions, standards and/or specifications of the enterprise.

Other Acts not listed here may also be pertinent to a Candidate's specific work environment. Applicants are expected to have a basic knowledge of the relevant Acts and to investigate whether any Acts are applicable to their particular work environment.

The Applicant should develop the ability to:


- identify applicable legal, regulatory, health and safety regulations requirements and standards for the complex engineering activity
- apply health and safety regulations and ensuring the safety of all affected persons through the use of safe and sustainable materials, components, processes and systems for the complex engineering activity
- identify risks and risk management strategies for the complex engineering activity.

The Applicant should be able to perform the following activities, among others:

- Demonstrate the required competence and academic qualifications and have performed engineering work or have taken responsibility for engineering work performed per category.
- Have a working knowledge of the related regulations and Acts and be able to demonstrate how this legislation affects their complex engineering activities at the requisite Responsibility level.
- Have a basic knowledge of the relevant Acts and investigate whether any Acts are applicable to their particular work environment.
- Have a working knowledge and functional understanding of the provisions of the Occupational Health and Safety Act, 85 of 1993 (OHS Act) and/or the Mine Health and Safety Act, 29 of 1996 (MHS Act) in their specific workplaces.
- Have a working knowledge of and familiarisation with field-specific, industry-specific regulations and requirements practices in the South African industry. The industry-specific regulations and requirements may or may not be applicable in all fields of Computer Engineering.

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4.1.8 Outcome 8: Conduct engineering activities ethically (Responsibility level E)

This outcome requires the Engineers to conduct themselves in an ethical manner, always demonstrating professionalism during the course of their complex engineering activities. They should conduct all engineering activities ethically. The Applicants should be capable of handling ethical issues and adopt a systematic approach to resolve ethical issues. Unethical behaviour may be in the form of fraud, corruption, maladministration or illegal activities.

The Applicant should develop the ability to:

- identify ethical problems, affected parties and the best solution to resolve the problem
- understand and apply ECSA's Rules of Conduct, a listing of ethics regarding integrity and competency; in addition, Applicants should have knowledge of the ECSA Code of Conduct with an understanding of how it relates to their area of practice
- pay attention to the health and safety of persons, area of competency, truth, integrity and honest behaviour as it is of paramount importance.

The Applicant should be able to perform the following activities, among others:


- Provide a clear problem identification analysis and best solution strategy.
- Understand how to apply the ECSA rules of conduct.

4.1.9 Outcome 9: Exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of complex engineering activities (Responsibility level E)

This outcome requires the Engineers to exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of complex engineering activities. Judgement is made in recognition of the complexity and assessing alternatives in light of competing requirements and incomplete knowledge. Judgement is expected in considering the interactions among conflicting technical, engineering, social or other issues and their far-reaching impact on affected parties in making recommendations.

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The Applicant should develop the ability to:


- develop options and final solutions or approaches that consider impacts, interrelationships with other disciplines, time, cost and other wider constraints, including the absence of full evidence
- take a holistic view of the solution while considering risks, their consequences and the implications for stakeholders and other affected parties.

The Applicant should be able to perform the following activities, among others:

- Identify and evaluate the technical risk during the design of new product or equipment and when considering the acquisition of any new technologies to solve complex problems.
- Conduct risk analysis to identify and mitigate risks for the design, build, implementation, application, security, technical, operational and support of new or design changes that may result in performance degradation, security breaches, system failures, increased maintenance time and significant amount of technical debt for the organisation.
- Implement and maintain a reliable analysis solution for technical-risk management to ensure early detection of problems.
- Evaluate risk situations in the absence of full evidence being available using risk management and decision-making tools and techniques.
- Generate documentary proof that a thorough investigation, analysis and identification of several factors have taken place and that the risks associated with certain decisions have been understood and mitigated.
- Demonstrate knowledge and understanding of the government legislation and regulations, organisational risk policies, and local and international standards.
- Identify or demonstrate that risks are evaluated under one or more practice areas, such as research and development, engineering systems design, advisory, planning and directing the development, construction, implementation and operation of computer, automation, cyber security, software systems, network, telecommunication and instrumentation hardware equipment and components.
- Using a new product or potential new product to solve a complex engineering problem, develop a risk analysis template to identify and mitigate risks for the design, build,

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implementation, application, security, technical, operational and support of new or design changes that may result in performance degradation, security breaches, system failures, increased maintenance time and significant amount of technical debt for the organisation.

- Demonstrate how risk identification techniques such as Brainstorming, SWOT Analysis, Delphi Technique, Root Cause Analysis, among others, have been used to evaluate a complex engineering problem.
- Demonstrate how risk analysis and assessment techniques such as Risk Matrix (Probability and Impact Matrix), Decision Tree, Failure Modes and Effects Analysis (FMEA), Bowtie Modelling, among others, have been used to assess a complex engineering problem.
- Demonstrate how risk response planning techniques such as Risk Avoidance, Risk Mitigation, Risk Transfer, Risk Acceptance, among others, have been used to respond to a complex engineering problem.
- Demonstrate how risk monitoring and control techniques such as Risk Register, Risk Reassessment, Risk Audits, among others, have been used to monitor and control a complex engineering problem.
- Undergo training courses in risk identification, techniques, planning, analysis, assessment, response, monitoring, control and legislation, among others.


4.1.10 Outcome 10: Be responsible for making decisions on part or all of complex engineering activities (Responsibility level E)

This outcome requires the Engineers to be responsible for making decisions on part or all of *complex engineering activities*. Having the contextual knowledge and operating at Level E of the Degree of Responsibility affords Candidates an opportunity to demonstrate how they were able to make decisions and take on responsibility for significant parts of one or more complex engineering activities. Engineers are responsible for making decisions on part, or all of complex engineering activities.

Responsible decision-making is typified by the systematic gathering of related information and checking of the facts and inputs required for the decision-making process. Engineers need to make the final decision, based on knowledge, past experience and seeking advice on matters falling outside their education and experience. Seeking advice or guidance from the relevant

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superiors assists Applicants to make informed decisions and assume responsibility for those decisions.

Engineers must keep a detailed record of the decision-making process and the reasons for the final decision. Engineers need to take responsibility and be prepared to be held accountable for the far-reaching and significant consequences (positive or negative).

The Applicant should develop the ability to:


- systematically gather related information and check facts and inputs required for the decision-making process
- make the final decision, based on knowledge, past experience and seeking advice on matters falling outside their education and experience
- record the decision-making process and the reasons for the final decision
- take responsibility and be prepared to be held accountable for far-reaching and significant consequences (whether positive or negative).

The Applicant should be able to perform the following activities, among others:

- Identify and evaluate how the technical risk of a design can negatively impact the project, system or entire infrastructure if the implementation is not as successful as anticipated.
- In developing engineering solutions, demonstrate by keeping and collating documents, records and decision registers, the factors taken into consideration during decision-making, bearing in mind risk, consequences in technology application and affected parties.
- Develop a decision-making template to demonstrate how applying engineering knowledge acquired from relevant academic institutions and accredited engineering programmes can be used to make effective decisions in solving broadly defined engineering problems.
- Responsible decision-making must also consider Disaster Recovery (DR) and Business Continuity Planning (BCP), particularly where system failure or downtime could disrupt operations, safety or data integrity. Engineers should ensure that systems are designed with backup, failover and recovery mechanisms in line with organisational and regulatory requirements. These decisions should be documented and form part of broader risk and impact mitigation strategies.

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- For example, when implementing ERP or MES systems, cloud platforms or control networks, Technologists must assess how outages could affect production or compliance. Decisions on redundancy, UPS, automated backups or communication failovers must be justified with respect to cost, complexity and recovery time. These choices should be clearly documented to reflect responsible engineering judgment.
- Expand the decision-making template to include considerations from engineering, social, environmental and sustainable development factors.
- Demonstrate how decision-making tools and techniques such as Decision Matrix, Pros/Cons Lists, Decision Tree, Cost-Benefit Analysis, Multi-voting Technique, Influence Diagram, Trial and Error, Pareto Analysis, SWOT Analysis, PEST Analysis, Feasibility Study, Kepner-Tregoe Method, among others, have been used to make decisions for a complex engineering problem.
- Attend decision-making training courses to gain familiarity with decision-making tools and techniques.


4.1.11 Outcome 11: Undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work (Responsibility level D)

This outcome requires the Engineers to undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. Engineers need to undertake continuing professional development (CPD) activities to maintain and extend their competencies. Engineers need to be able to explain awareness and develop a strategy to independently enhance professional development. Engineers need to collect evidence of self-development in their chosen and new areas of expertise and personal development. Professional development involves taking ownership and independently planning, selecting, undertaking and recording appropriate activities to extend competence.

Record-keeping must not be left to the employer or anybody else. Trainees must manage their own training independently by taking initiative and being in charge of experiential development towards the level of Professional Engineer.

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The Applicant should develop the ability to:


- explain awareness and develop a strategy to independently enhance professional development
- provide evidence of self-development in chosen and new areas of expertise and personal development
- demonstrate the strategy to identify new and emerging technologies, concepts and tools
- demonstrate the strategy to incorporate identified new and emerging technologies in the self-development activity planning
- demonstrate the process for record-keeping of self-development activities.

The Applicant should be able to perform the following activities, among others:

- Attend work, engineering and industry-related learning and training activities in the following areas among others:
 - Project management such as PMBOK or PRINCE, Conditions of Contract / Value Engineering – New Engineering Contract (NEC), Joint Building Contract Committee (JBCC), etc, hardware, software, data modelling and cyber security concepts and standards (MESA, ISA, IEEE, IEC etc), hardware and software systems, architecture models and standards (RAMI 4.0, Zachman Framework, OMAC [Organisation for Machine Automation and Control], SCOR [Supply Chain Council], OAGIS [Open Application Group for Industry], OPC Unified Architecture [OPC Foundation], condition based operations [MIMOSA]), hardware and software specifications, business analysis, business process modelling tools and techniques and preparation of specifications, negotiation skills, process optimisation and continuous improvement concepts, tools and techniques (6 Sigma, TQM, Lean, JIT 5S, etc), engineering finance, risk analysis, hazard and operability (HAZOP) study methods and techniques, quality systems and standards, occupational health and safety, computer health and safety, food safety and hygiene (Hazard Analysis & Critical Control Points), engineering ethics, discipline-specific courses, energy efficiency, maintenance engineering, environment impacts, people management, finance management, report

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writing, planning methods and tools, system engineering, industrial relations and public speaking, etc.

- Training and courses that do not carry official CPD points are also appropriate, such as courses or training offered within the employer organisation or by other organisations.

4.2 Training for registration as a Professional Engineering Technologist

4.2.1 Outcome 1: Define, investigate and analyse broadly defined engineering problems (Responsibility level D)

This outcome requires the Applicant to define, investigate, and analyse *broadly defined engineering problems* that arise during the application and operation of computer-based systems. These problems typically occur within established technologies, methods and standards, and may relate to system performance, integration, configuration or maintenance.

The problems are characterised by clear objectives, multiple possible solutions and known constraints, typically requiring the application of **sound technical judgment and established engineering methods**, rather than original research or theory development.

The Applicant should develop the ability to:


- identify and define broadly defined problems in computer or embedded systems and outline appropriate procedures for solving them
- investigate and evaluate relevant technical information, using standard tools and diagnostics to assess the performance or failure of system components or subsystems
- apply existing engineering principles and data to analyse system behaviour, identify probable causes and determine corrective actions.

The Applicant should be able to perform the following activities, among others:

- Provide structured definitions and framing of broadly defined problems, such as communication breakdowns, timing mismatches or system bottlenecks.
- Investigate common issues in computing systems using logs, diagnostic outputs, performance counters or feedback from users/operators. Examples include system

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crashes, timing delays in control loops or degraded performance in production environments.

- Conduct performance analysis in existing computer-based systems to evaluate throughput, latency and resource usage under varying operating conditions.
- Analyse and troubleshoot communication-related failures in systems using industrial and standard protocols (e.g., OPC UA, Modbus, CAN, MQTT, TCP/IP, UDP).
- Use discipline-specific tools such as protocol analysers (e.g., Wireshark), logic analysers, or embedded debugging tools to conduct systematic fault-finding.
- Apply diagnostic methods to identify and resolve issues such as packet loss, unstable synchronisation, memory usage inefficiencies or misconfigured security settings.
- Compile structured technical reports outlining problems, findings and recommendations for corrective or preventative actions.
- Attend relevant training, workshops or vendor-specific courses to build and maintain competency in systems analysis and diagnostics.

4.2.2 Outcome 2: Design or develop solutions to broadly engineering problems (Responsibility levels C and D)

This outcome requires the Applicant to design or develop practical and effective solutions to broadly defined engineering problems that occur in the context of computer-based systems. These problems are characterised by clear objectives, multiple applicable technologies or methods, and known constraints.


The design activity involves applying established engineering principles, following standards, using commercially available tools and components and considering factors such as cost, safety, reliability and sustainability. Technologists are expected to use technical judgment to adapt known solutions to meet defined requirements, rather than to develop novel solutions from first principles.

The Applicant should develop the ability to:

- design or develop solutions for broadly defined problems using existing methods, tools and design principles

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- translate user or system requirements into technical specifications for implementation, using discipline-specific knowledge and established technologies
- consider key trade-offs in the design process, such as cost, performance, reliability, safety, scalability and maintainability
- select and configure technologies, tools and systems appropriate to the project context and industry requirements
- validate designs through prototyping, simulation or standard testing methods.


The Applicant should be able to perform the following activities, among others:

- Provide designs and solutions for computing systems by translating problem statements into functional and non-functional requirements, selecting appropriate technologies (e.g., microcontrollers, protocols, platforms, frameworks) based on defined needs and constraints and considering trade-offs such as cost, safety, performance, energy use and integration with existing systems.
- Apply established engineering design methodologies such as object-oriented design for software systems, layered or microservices architecture for distributed systems and real-time patterns for embedded or control systems
- Incorporate applicable engineering standards and best practices, including protocols such as OPC UA, MQTT, TCP/IP, Modbus, CAN; software lifecycle standards, i.e., ISO/IEC 12207 and industrial standards: ISA-95, ISA-88, ISA-106, ISA/IEC-62443.
- Produce structured and traceable documentation that outlines design assumptions, decisions and rationale; interface definitions and implementation guides; and project specifications and compliance references.
- Develop and validate prototypes or working implementations using simulators, test rigs, emulators, breadboards, or test environments; and vendor configuration tools, IDEs and standard diagnostic software.

Example Applications: Developing a modular MES software system using microservices architecture: configuring and deploying a secure IoT gateway using MQTT and TLS; integrating OPC UA telemetry with a SCADA system for process visibility; designing and validating a low-power embedded controller for field sensors; deploying a distributed

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control network with redundancy using CAN and failover logic; or customising an edge/cloud computing setup for ML inference in a smart factory.

- Attend structured training or vendor-specific certification programmes to build competence in design tools and domain-specific practices.

4.2.3 Outcome 3: Comprehend and apply knowledge that is embodied in established engineering practices that is specific to the jurisdiction in which the Engineering Technician practices (Responsibility level E)

This outcome requires Applicants to comprehend and apply established, discipline-specific engineering knowledge relevant to their practice area, including understanding of local, regulatory and industry-specific contexts. Engineering Technologists are expected to use well-established engineering principles and methods to solve broadly defined problems that typically occur in familiar technological contexts.

The knowledge applied should include:

- concepts and techniques acquired during an NQF Level 7 qualification (e.g., BTech, BEngTech)
- applicable engineering standards, regulations, codes of practice and procedures
- an awareness of broader economic, environmental, societal and legal factors influencing the chosen solution.


Unlike Engineers, Technologists are not expected to derive solutions from first principles, but rather to apply known and proven methods and tools to solve defined technical problems and contribute to the real-world implementation of engineering projects.

The Applicant should develop the ability to:

- apply established engineering knowledge and procedures to practical challenges in their discipline
- understand the influence of contextual factors such as industry requirements, regulatory frameworks and environmental or community concerns
- recognise how their work relates to and interacts with other engineering and non-engineering disciplines within a project or system

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- demonstrate knowledge of relevant legal, regulatory and financial requirements applicable to their area of practice.

The Applicant should be able to perform the following activities, among others:

- Apply engineering standards, codes and regulations to select or implement appropriate technologies in system integration, upgrade or modification tasks.
- Demonstrate working knowledge of related disciplines (e.g., networking, electrical, mechanical, software) when applying engineering methods across systems or within a team.
- Provide practical, discipline-specific design or configuration input based on established engineering practice and guided by manuals, software tools or industry norms.
- Analyse system behaviour using standard techniques or vendor tools and make judgments based on known engineering practices.
- Apply local legislation, safety rules and risk considerations in equipment setup, documentation or operational decisions.
- Assist in preparing cost-effective implementation or improvement plans with consideration of financial and legal boundaries.
- Use simulation or vendor tools (e.g., network design tools, embedded system configuration tools) to confirm system choices.
- Attend technical training, vendor certification or standards updates to remain aligned with current technologies and compliance requirements.


4.2.4 Outcome 4: Manage part or all of one or more broadly defined engineering activities (Responsibility level D)

This outcome requires the Applicant to demonstrate the ability to manage part or all of one or more *broadly defined engineering activities*. The focus is on planning, organising, coordinating and monitoring work within a structured engineering context – typically involving known technologies, industry standards and defined objectives.

Management activities may include overseeing the implementation of engineering solutions, leading project tasks or teams, managing resources and timelines, coordinating with

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stakeholders and ensuring compliance with quality and safety standards. The role requires consistent application of engineering judgment, accountability for deliverables and familiarity with standard project management approaches.


The Applicant should develop the ability to:

- manage people, work priorities, tools and resources in delivering broadly defined engineering tasks
- plan and execute engineering activities to meet technical, time, cost and quality objectives
- coordinate with clients, suppliers and internal stakeholders to maintain alignment and resolve issues
- apply standard engineering management practices such as Agile, Waterfall or CI/CD depending on the context
- maintain compliance with contractual, safety, environmental and regulatory obligations.

The Applicant should be able to perform the following activities, among others:

- Plan and oversee engineering tasks such as system configuration, software deployment, equipment commissioning, or technical upgrades – ensuring completion on time and within scope.
Example: Planning the deployment of a site-wide MES upgrade while coordinating with operations and IT teams to ensure minimal disruption.
- Define and manage deliverables, team roles, resources and timelines for assigned engineering work packages or sub-projects.
Example: Coordinating hardware and software testing schedules during a SCADA system retrofit.
- Lead small teams or supervise contractors and technicians during the execution phase, maintaining adherence to design intent and documentation.
Example: Leading an IoT integration team responsible for installing edge devices and configuring communication protocols.

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- Track project progress, identify bottlenecks or technical risks, using tools such as RAID (risks, actions, issues and decisions or dependencies) logs and implement mitigation or corrective actions.

Example: Identifying delays in a firmware rollout due to hardware compatibility issues and adjusting the delivery plan.


- Apply commonly used management approaches such as Agile/Scrum for iterative software or firmware projects; Waterfall or V-model for structured or safety-focused system; implementations; and CI/CD tools for continuous testing, delivery and deployment of applications
- Use tools like Gantt charts, Kanban boards or software (e.g., Jira, MS Project, Git) to plan, monitor and document engineering tasks.
- Manage engineering-related documentation including test plans, deployment logs, version control records and handover reports.
Example: Using Git (Global information tracker) to manage firmware changes and track integration milestones in an embedded systems project.
- Communicate effectively with project stakeholders – translating technical information into actionable items for clients, suppliers, and internal team members.
Example: Updating clients on implementation progress and aligning expectations for system acceptance testing.
- Monitor and control resource usage, ensuring cost-efficiency and alignment with safety, quality, and environmental constraints.
- Attend relevant training in project planning, risk mitigation, or vendor-specific deployment tools to maintain management competency.

4.2.5 Outcome 5: Communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of engineering activities (Responsibility level C)

This outcome requires Candidate Technologists to communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of their broadly defined engineering activities. They should communicate effectively both orally and in writing, with engineering audiences and the community at large and convey technical information

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through written reports, presentations and technical documentation, as well as collaborating with team members, clients and other stakeholders in their broadly defined engineering activities. Candidate Technologists communicate the engineering activities to relevant stakeholders, managers and supervisors on the work deliverables.

The Applicant should develop the ability to:


- write clear, concise, effective and technically, legally and editorially correct reports using a structure and a style that meet communication objectives and user/audience requirements.
- issue clear and concise instructions and/or guidance, being cognisant of the audience and various skill levels
- deliver structured oral presentations using appropriate language, visual aids and supporting materials for the intended audience and purpose.

The Applicant should be able to perform the following activities among others:

- Write specifications for the purchase of materials and/or work to be done, make recommendations on tenders that are received, place orders and variation orders, write work instructions, and report on work done.
- Draw, correct and revise drawings, compile test reports, use operation and maintenance manuals to write work procedures, write inspection and audit reports, write commissioning reports, and prepare and present motivations for new projects.
- Compile budget reports and report on various issues such as studies done and calculations carried out, customer requirements, safety incidents and risk analysis, equipment failure, proposed system improvement, new techniques and cost control.
- Prepare technical documentation for custom-developed software systems, including functional specifications, configuration guidelines, API usage instructions, user manuals, and system integration notes to support development, deployment and user training.
- Compile detailed bug reports, change requests, or test summaries during software development or system integration phases – clearly outlining observed issues, steps to reproduce, system behaviour, and proposed resolutions, using structured formats (e.g., Jira, Git (Global information tracker) issue trackers, internal QA documents).

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4.2.6 Outcome 6: Recognise the reasonably foreseeable economic, social, cultural and environmental effects of broadly defined engineering activities seeking to achieve sustainability (Responsibility level B)

This outcome requires Candidate Technologists to recognise the reasonably foreseeable economic, social, cultural and environmental effects of broadly defined engineering activities seeking to achieve sustainability. The outcome requires the Applicants to recognise and address the impact of their broadly defined engineering activities on these components and where there are negative effects, provide mitigating measures.


Risk and impact mitigation must include the probability and impact of all the risks connected with the project. The risk document must be a live document through the life cycle of a project and may include technical risk, environmental risk, quality risk, commercial risk, schedule risk, social risk, cultural risk and construction risk. Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs and press releases.

The Applicant should develop the ability to:

- identify interested and affected parties and their expectations with regard to technical, sociocultural and environmental effects, while considering the economics and long-term sustainability of the broadly defined engineering activities
- recognise and address the impact of their broadly defined engineering activities on social, cultural and environmental components
- identify the risk negative impact of the broadly defined engineering activities on the components and develop plans and measures to mitigate the negative effects of broadly defined engineering activities
- integrate sustainability and ethics into the decision-making process throughout the project lifecycle.

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The Applicant should be able to perform the following activities, among others:

- Develop a comprehensive workforce development plan to ensure the availability of skilled labour, collaborate with local institutions and provide training programmes to enhance the local workforce's skills.
- Engage with local government authorities to understand the local bylaws and regulations.
- Develop a long-term financial plan to ensure the project's sustainability and minimise financial risks.
- Conduct a thorough risk assessment and implement robust safety protocols and emergency response plans. Engage with local communities to address their concerns and provide regular updates on safety measures.
- Develop a community engagement plan to communicate project timelines, potential disruptions and mitigation measures. Implement strategies to minimise noise, dust and traffic impacts during construction.
- Conduct a cultural heritage assessment to identify and protect any significant sites; engage with indigenous communities and respect their cultural values and traditional knowledge; and develop a cultural heritage management plan to mitigate any potential impacts.
- Engage with local community leaders and stakeholders to understand their concerns and aspirations and develop a community development plan that includes initiatives to support local businesses, education, healthcare and infrastructure development.
- Implement advanced pollution control technologies and monitoring systems; develop a comprehensive waste management plan to minimise and properly dispose of hazardous waste; and comply with local environmental regulations and standards.
- Conduct an environmental impact assessment to identify sensitive habitats and species; develop a biodiversity conservation plan that includes habitat restoration and protection measures; and implement sustainable practices such as energy and water conservation, waste reduction and recycling.

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4.2.7 Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons during all broadly defined engineering activities (Responsibility level E)


This outcome requires Candidates to develop a working knowledge of the related regulations and Acts and to be able to demonstrate how this legislation affects their broadly defined engineering activities. They are required to meet all legal and regulatory requirements and protect the health and safety of persons during all broadly defined engineering activities.

All engineering work must be carried out in accordance with the norms of the profession. Such norms are generally represented by national and international standards, industry standards, codes of practice and best practice guidelines. Candidates are expected to have a basic knowledge of the applicable Acts that are applicable to their area of practice. The list of common Acts and regulatory standards, among others, in the Computer Engineering profession is below:

- Engineering Profession Act, 46 of 2000
- Occupational Health and Safety Act, 85 of 1993
- National Building Regulations and Building Standards Act, 103 of 1977
- National Environmental Management Act, 107 of 1998
- Employment Equity Act, 55 of 1998
- Mine Health and Safety Act, 29 of 1996
- Occupational Health and Safety Act, 85 of 1993 and Regulations
- Specific work instructions, standards, and/or specifications of the enterprise
- Protection of Personal Information Act, 4 of 2013
- Specific work instructions, standards and/or specifications of the enterprise.

Other Acts not listed here may also be pertinent to a Candidate's specific work environment. Applicants are expected to have a basic knowledge of the relevant Acts and to investigate whether any Acts are applicable to their particular work environment.

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The Applicant should develop the ability to:


- identify applicable legal, regulatory, health and safety regulations requirements and standards for the broadly defined engineering activity
- apply health and safety regulations and ensuring the safety of all affected persons through the use of safe and sustainable materials, components, processes and systems for the broadly defined engineering activity
- identify risks and risk management strategies for the broadly defined engineering activity.

The Applicant should be able to perform the following activities, among others:

- Have a working knowledge of the related regulations and Acts and be able to identify and demonstrate how this legislation affects their broadly defined engineering activities at the requisite Responsibility level. They should also have a basic knowledge of the relevant Acts and to investigate whether any Acts are applicable to their work environment. They should further have a working knowledge and familiarity with field-specific, industry-specific regulations and requirements practices in the South African industry. The industry-specific regulations and requirements may or may not be applicable to all fields of Computer Engineering.
- Have a working knowledge and functional understanding of the provisions of the OHS Act and/or the MHS Act in their specific workplaces. Activities include conducting regular health and safety assessments to identify and address workplace hazards; provide training and education on occupational health and safety practices to employees; ensuring compliance with regulations related to noise exposure, hazardous substances and ergonomics; establishing incident reporting and investigation procedures to identify the root causes and prevent future occurrences; and implementing measures to prevent work-related injuries and illnesses, such as proper ergonomics, regular breaks and medical surveillance programmes.
- Demonstrate awareness and working knowledge of health and safety regulations. This could involve implementing safety protocols, conducting risk assessments and ensuring compliance with relevant safety standards. Examples could include implementing a safety management system to identify and mitigate Computer Engineering risks; regularly inspecting and maintaining equipment and infrastructure to ensure their safe operation;

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providing workers with appropriate personal protective equipment (PPE) and ensuring its proper use; conducting safety training programmes for employees to enhance their awareness and knowledge of safety procedures; and establishing emergency response plans and conducting drills to prepare for potential accidents or incidents.

- Demonstrate awareness and have a working knowledge and functional understanding of risks and risk management strategies associated with Computer Engineering activities. This could involve implementing safety measures, conducting hazard analyses and developing emergency response plans. Examples could include the following: Hazard Analysis and Critical Control Points (HACCP), Computer Engineering Safety Management, Emergency Response Planning, Environmental Impact Assessments (EIAs) and Waste Management.

4.2.8 Outcome 8: Conduct engineering activities ethically (Responsibility level E)

This outcome requires the Candidate Technologists to conduct themselves in an ethical manner, always demonstrating professionalism during the course of their *broadly defined* engineering activities. They should conduct engineering activities ethically. The Applicants should be capable of handling ethical issues and adopting a systematic approach to resolve ethical issues. Unethical behaviour may be in the form of fraud, corruption, maladministration or illegal activities.

The Applicant should develop the ability to:


- identify ethical problems, affected parties and the best solution to resolve the problem
- understand and apply ECSA's Rules of Conduct, a listing of ethics regarding integrity and competency. In addition, Applicants should have knowledge of the ECSA Code of Conduct with an understanding of how it relates to their area of practice
- pay attention to the health and safety of persons, area of competency, truth, integrity and honest behaviour as it is of paramount importance.

The Applicant should be able to perform the following activities, among others:

- Provide a clear problem identification analysis and best solution strategy. Ethical problems such as tender fraud and corruption, bribery payment, favouritism, defamation,

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fraudulent overtime claims, fraudulent expenses claimed, fraudulent qualifications, misrepresentation of facts and overstating of compensation events may occur. Problem solutions should consider various factors, including the potential risks, available alternatives and legal requirements. They may consult with other professionals to determine the best course of action or alternatives.

- Provide understanding and application of the ECSA rules of conduct. Most engineering projects are multi-disciplinary in nature, with many role players performing speciality work that could result in individuals conducting engineering activities they have no education, training or competency for. It is imperative that Applicant Computer Engineering Technologists familiarise themselves with ECSA's Rules of Conduct: Ethics regarding integrity and competency.

4.2.9 Outcome 9: Exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of broadly defined engineering activities (Responsibility level E)


This outcome requires the engineering technologist to exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of broadly defined engineering activities. Judgement is made by considering impacts, interrelationships with other disciplines, time, cost and other constraints, in the light of information that is ill-posed, is under or over specified and requires identification and refinement into the technology area. Judgement is expected in considering the interactions between technical, engineering, social or other issues and their impact in the practice area (but may extend more widely) and on affected parties in making recommendations.

The Applicant should develop the ability to:

- develop options and final solutions or approaches that consider impacts, interrelationships with other disciplines, time, cost and other constraints, in the light of limited knowledge
- take a wide-ranging view of the solution while considering risks, their consequences and the implications for stakeholders and other affected parties.

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The Applicant should be able to perform the following activities, among others:

- Identify and evaluate the technical risk during the design of new product or equipment and when considering the acquisition of any new technologies to solve broadly defined problems.
- Conduct risk analysis to identify and mitigate risks for the design, build, implementation, application, security, technical, operational and support of new or design changes that may result in performance degradation, security breaches, system failures, increased maintenance time and significant amount of technical debt for the organisation.
- Implement and maintain a reliable analysis solution for technical-risk management to ensure early detection of problems.
- Evaluate risk situations in the light of limited information being available using risk management and decision-making tools and techniques.
- Generate documentary proof that a thorough investigation, analysis and identification of several factors have taken place and that the risks associated with certain decisions have been understood and mitigated.
- Demonstrate knowledge and understanding of the government legislation and regulations, organisational risk policies and local and international standards.
- Identify or demonstrate that risks are evaluated under one or more practice areas, such as research and development, engineering systems design, advisory, planning and directing the development, construction, implementation and operation of computer, automation, cyber security, software systems, network, telecommunication and instrumentation hardware equipment and components.
- Using a new or potential new product or software system to solve a broadly defined engineering problem, develop a risk analysis template to identify and mitigate risks for the design, build, implementation, application, security, technical, operational and support of new or design changes that may result in performance degradation, security breaches, system failures, increased maintenance time and significant amount of technical debt for the organisation.

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- Demonstrate how risk identification techniques such as Brainstorming, SWOT Analysis, Delphi Technique, Root Cause Analysis, among others, have been used to evaluate a broadly defined engineering problem.
- Demonstrate how risk analysis and assessment techniques such as Risk Matrix (Probability and Impact Matrix), Decision Tree, Failure Modes and Effects Analysis (FMEA), Bowtie Modelling, among others, have been used to assess a broadly defined engineering problem.
- Demonstrate how risk response planning techniques such as Risk Avoidance, Risk Mitigation, Risk Transfer, Risk Acceptance, among others, have been used to respond to a broadly defined engineering problem.
- Demonstrate how risk monitoring and control techniques such as Risk Register, Risk Reassessment, Risk Audits, among others, have been used to monitor and control a broadly defined engineering problem.
- Undergo training courses in risk identification, techniques, planning, analysis, assessment, response, monitoring, control and legislation, among others.


4.2.10 Outcome 10: Be responsible for making decisions on part or all of broadly defined engineering activities (Responsibility Level E)

This outcome requires the Engineering Technologist to be responsible for making decisions on part or all of *broadly defined engineering activities*. Having the coherent and detailed engineering knowledge underpinning the applicable technology area and operating on Level E of Degree of Responsibility affords Candidates an opportunity to demonstrate how they were able to make decisions and take on responsibility for significant parts of one or more broadly defined engineering activities. Engineering Technologists are responsible for making decisions on part, or all of broadly defined engineering activities.

Responsible decision-making is typified by the systematic gathering of related information and checking of the facts and inputs required for the decision-making process. Engineering Technologists need to make the final decision, based on knowledge, past experience and seeking advice on matters falling outside their education and experience. Seeking advice or guidance from relevant superiors assists Applicants to make informed decisions and assume responsibility for those decisions.

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Engineering Technologists must keep a detailed record of the decision-making process and the reasons for the final decision. Engineering Technologists need to take responsibility and be prepared to be held accountable for significant consequences that are important in the practice area but may extend more widely (positive or negative).

The Applicant should develop the ability to:


- systematically gather related information and check facts and inputs required for the decision-making process
- make the final decision, based on knowledge, past experience and seeking advice on matters falling outside the Applicant's education and experience
- record the decision-making process and the reasons for the final decision
- take responsibility and be prepared to be held accountable for significant consequences that may extend widely (whether positive or negative).

The Applicant should be able to perform the following activities, among others:

- Identify and evaluate how technical risk of a design can negatively impact the project, system or entire infrastructure in the event that the implementation is not successful as anticipated.
- In developing engineering solutions, demonstrate by keeping and collating documents, records, decision registers and the factors taken into consideration during decision-making, bearing in mind risk, consequences in technology application and affected parties.
- Where the engineering solution is partially outside standards and codes, develop a Gap-Analysis template, showing the variation from standard and the justification to operate outside these standards and codes.
- Technologists must also apply responsible decision-making to areas such as Disaster Recovery (DR) and Business Continuity Planning (BCP), especially where system downtime or data loss could impact operations, safety or compliance. This involves incorporating backup, failover and recovery mechanisms into system designs, and ensuring these align with business and regulatory requirements. Such decisions must be clearly documented as part of risk and systems planning.

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- Develop a decision-making template to demonstrate how applying engineering knowledge acquired from relevant academic institutions and accredited engineering programmes can be used to make effective decisions in solving broadly defined engineering problems.
- Expand the decision-making template to include considerations from engineering, social, environmental and sustainable development factors.
- Demonstrate how one or more decision-making tools and techniques such as Decision Matrix, Pros/Cons Lists, Decision Tree, Cost-Benefit Analysis, Multi-voting Technique, Influence Diagram, Trial and Error, Pareto Analysis, SWOT Analysis, PEST Analysis, Feasibility Study, Kepner-Tregoe Method, among others, have been used to make decisions for a complex engineering problem.
- Attend decision-making training courses to gain familiarity with decision-making tools and techniques.


4.2.11 Outcome 11: Undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work (Responsibility level D)

This outcome requires the engineering technologist to undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. Engineering Technologists need to undertake CPD activities to maintain and extend their competencies. Engineering Technologists need to be able to explain awareness and develop a strategy to independently enhance professional development. Engineering Technologists need to collect evidence of self-development in their chosen and new areas of expertise and personal development. Professional development involves taking ownership and independently planning, selecting, undertaking and recording appropriate activities to extend competence.

Record-keeping must not be left to the employer or anybody else. Trainees must manage their own training independently by taking initiative and being in charge of experiential development towards the level of Professional Technologist.

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The Applicant should develop the ability to:


- explain awareness and have a strategy to independently enhance professional development
- provide evidence of self-development in chosen and new areas of expertise and personal development
- demonstrate the strategy to identify new and emerging technologies, concepts and tools
- demonstrate the strategy to incorporate identified new and emerging technologies in self-development activity planning
- demonstrate the process for record-keeping of self-development activities.

The Applicant should be able to perform the following activities, among others:

- Attend work, engineering and industry-related learning and training activities in the following areas, among others:
 - Project management such as PMBOK or PRINCE, Conditions of Contract / Value Engineering – New Engineering Contract (NEC), Joint Building Contract Committee (JBCC), etc, hardware, software, data modelling and cyber security concepts and standards (MESA, ISA, IEEE, IEC etc), hardware and software systems architecture models and standards (RAMI 4.0, Zachman Framework, OMAC [Organisation for Machine Automation and Control], SCOR [Supply Chain Council], OAGIS [Open Application Group for Industry], OPC Unified Architecture [OPC Foundation], condition based operations [MIMOSA]), hardware and software specifications, business analysis, business process modelling tools and techniques and preparation of specifications, negotiation skills, process optimisation and continuous improvement concepts, tools and techniques (6 Sigma, TQM, Lean, JIT 5S, etc), engineering finance, risk analysis, HAZOP study methods and techniques, quality systems and standards, occupational health and safety, computer health and safety, food safety and hygiene (Hazard Analysis & Critical Control Points), engineering ethics, discipline-specific courses, energy efficiency, maintenance engineering, environment impacts, people management, finance management, report writing, planning methods and tools, system engineering, industrial relations and public speaking, etc.

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- Training and courses that do not carry official CPD points are also appropriate, such as courses or training offered within the employer organisation or by other organisations.

4.3 Training for registration as a Professional Engineering Technician

4.3.1 Outcome 1: Define, investigate and analyse well-defined engineering problems (Responsibility level C)

This outcome requires the Applicant to define, investigate and analyse well-defined engineering problems that arise in the implementation, operation or maintenance of computer-based systems. These problems occur within known specifications, standard procedures and established technologies.

Well-defined problems typically have clear objectives, standardised methods for resolution and a predictable range of outcomes. The Technician applies procedural knowledge, follows standard documentation and uses approved diagnostic tools to identify and solve these problems, escalating complex issues where necessary.

The Applicant should develop the ability to:


- recognise and define well-defined technical problems in computer, embedded or control systems by interpreting specifications, user reports or system behaviour
- apply established diagnostic methods and tools to locate faults or underperformance in line with known system parameters
- follow approved procedures to resolve routine engineering issues, ensuring that solutions are compliant with industry standards and manufacturer specifications
- escalate non-routine or complex issues to technologists or engineers when they fall outside defined boundaries.

The Applicant should be able to perform the following activities, among others:

- Interpret engineering drawings, data sheets and user documentation to identify and understand system configurations.
- Carry out system checks and diagnostics using defined procedures, for example:
 - Using standard test patterns to verify sensor or actuator functionality.

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- Running software diagnostics to verify communication between devices or modules.
 - Re-indexing slow responding or degraded databases.
 - Running software diagnostics and simple processes to monitor network speed, resource load, query speed and query counts over time to identify areas (or times) of resource congestion.
- Assist in identifying the source of routine faults such as misconfigured IP settings, connector faults or power supply issues.
 - Use appropriate diagnostic tools (e.g., multimeters, handheld protocol testers, basic network analysers) to confirm symptoms and verify proper operation of subsystems.
 - Perform basic troubleshooting on systems using standard protocols (e.g., OPC UA, Modbus, CAN, TCP/IP), such as identifying disconnected devices or addressing configuration mismatches.
 - Record all diagnostic steps, test results and actions taken in structured maintenance or incident reports.
 - Apply safety and compliance checks (e.g., grounding, enclosure inspection, correct wiring) as per manufacturer and organisational requirements.
 - Participate in training and practical workshops to build proficiency in fault finding, system testing and preventative maintenance of computing and control systems.
 - Modify or configure existing scripts, HMI screens or control logic (e.g., PLC programs or embedded parameters) as per standard procedures or vendor guidelines and report any unexpected system behaviour or code faults for further investigation.
 - Assist in installing, configuring and updating software applications or firmware in embedded or networked systems by following standard procedures and vendor documentation; identify and report software-related faults such as incorrect versioning, failed updates or user configuration errors.

4.3.2 Outcome 2: Design or develop solutions to well-defined engineering problems (Responsibility levels C and D)

This outcome requires Applicants to assist in implementing or adapting solutions to well-defined engineering problems by following established procedures, standards and instructions.

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Technicians are expected to interpret and apply known design specifications, install or configure components and systems, and perform practical verification and maintenance within clearly defined parameters.

The solutions involve applying procedural and operational knowledge to support system function, ensure compliance with safety and quality standards and confirm correct operation through testing and feedback. Problem-solving is based on predefined methods rather than creative or analytical design.

The Applicant should develop the ability to:


- implement and configure engineering solutions in accordance with predefined specifications and design instructions
- interpret technical documentation, wiring diagrams, installation manuals, and software configuration guides
- apply relevant industry standards, safety regulations, and manufacturer procedures during implementation
- identify basic issues or variances during installation or operation and escalate where necessary
- contribute to design execution by providing practical input or improvements based on field conditions or operational feedback.

The Applicant should be able to perform the following activities, among others:

- Assemble, install or wire components in a computing, control or instrumentation system based on pre-approved designs.
- Configure embedded systems, PLCs or network devices using vendor software or standard tools according to technical documentation.
- Install and verify sensor and actuator connections using I/O maps, addressing schemes, and fieldbus protocols such as Modbus, CAN or Ethernet/IP.
- Assist in the implementation of software updates, firmware flashing or basic HMI configuration, under supervision or guidance.

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- Conduct standard functional tests and report pass/fail status for hardware or system verification.
- Use standard testing equipment (e.g., multimeters, handheld analysers, diagnostic software) to confirm correct installation and operation.
- Document test results, installation steps or deviations for maintenance logs or commissioning reports.
- Participate in the assembly or prototyping of devices using breadboards, development kits or pre-configured modules.
- Adhere to applicable standards and safety protocols (e.g., SANS 10142, ISO 13849, OHSA) during all field activities.
- Attend practical training and workshops to remain updated on tools, configuration software and standards relevant to the Technician's role.
- Perform basic code-level fault-finding by reviewing output logs, variable values or system messages using IDE tools or debugging consoles.
- Use vendor-provided diagnostic software or simulators to trace software-related errors in PLC, HMI or embedded control programs.
- Modify or update configuration files, startup scripts or parameters in embedded systems as part of a commissioning or maintenance task.
- Monitor system performance using dashboards or diagnostic tools and escalate abnormal behaviour such as dropped messages, failed inputs or watchdog resets.
- Conduct step-by-step testing of software-controlled sequences in automation or control systems to verify logic correctness and flag inconsistencies.
- Assist in version control activities (e.g., checking firmware/software version, logging changes, updating deployment records).
- Support troubleshooting of basic communication or software integration issues between devices (e.g., incorrect baud rate, misaligned tags, or protocol mismatch).

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4.3.3 Outcome 3: Comprehend and apply knowledge that is embodied in established engineering practices that is specific to the jurisdiction in which the Engineering Technician practises (Responsibility level E)

This outcome requires Applicants to demonstrate an understanding of standard engineering knowledge and procedures applicable to their discipline and to apply this knowledge in practical, well-defined engineering contexts. This includes the ability to work with established engineering standards, procedures and regulations, and to understand how legal, environmental, safety and social factors influence day-to-day engineering work.

Technicians are expected to apply this knowledge in the execution of installation, operation, maintenance and basic troubleshooting tasks under supervision or within well-defined limits, without the need to create new methods or derive solutions from first principles.

The Applicant should develop the ability to:


- apply practical engineering knowledge acquired through formal training and workplace experience to standard engineering tasks in their area of practice
- follow documented procedures, safety standards and manufacturer specifications in performing technical work
- recognise how their work fits into broader engineering activities and how it may affect or be affected by legal, regulatory, environmental or safety considerations
- communicate and collaborate effectively with team members, supervisors and clients regarding technical activities and compliance matters.

The Applicant should be able to perform the following activities, among others:

- Follow established safety, environmental and operational procedures when installing or maintaining equipment or systems.
- Apply applicable standards, regulations, and codes of practice (e.g., SANS, ISO, OHSA) during routine technical activities.
- Interpret and work from engineering drawings, circuit diagrams, datasheets and user manuals.

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- Understand and comply with legal and regulatory requirements applicable to tasks, e.g., grounding, EMC compliance, or PoPIA considerations in data systems.
- Assist in compiling documentation for compliance audits, maintenance records or quality checks.
- Identify and act on safety hazards or non-compliance issues during operations or installations.
- Recognise how financial and scheduling constraints affect task prioritisation and project execution.
- Attend relevant training or certification courses to stay current with standards, manufacturer tools and best practices in the discipline.

4.3.4 Outcome 4: Manage part or all of one or more well-defined engineering activities (Responsibility level D)

This outcome requires Applicants to demonstrate the ability to manage and coordinate *well-defined engineering activities* within a supervised or structured environment. These activities typically involve routine planning, resource coordination and task execution for projects or systems that follow established methods and clearly defined outcomes.


Technicians are expected to organise their own work, assist in managing small teams or contractors, coordinate logistics or equipment and ensure that engineering work is carried out safely, efficiently and in accordance with standards and instructions.

The Applicant should develop the ability to:

- plan and organise day-to-day technical work according to predefined project or maintenance schedules
- supervise or coordinate small groups of technicians or contractors performing well-defined engineering tasks
- ensure the availability of materials, tools, documentation and safety equipment needed for assigned work
- monitor progress, report issues and maintain compliance with relevant procedures, quality standards and safety regulations

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- communicate effectively with supervisors, team members and stakeholders involved in task execution.

The Applicant should be able to perform the following activities, among others:

- Plan and coordinate installation, testing or maintenance work packages based on drawings, checklists or standard operating procedures.
Example: Coordinating the installation of field sensors and I/O wiring for a SCADA system according to layout plans.
- Monitor the progress of assigned technical tasks, identify basic issues and notify supervisors of delays, resource shortages, or technical challenges.
Example: Escalating network configuration delays during commissioning of a remote monitoring system.
- Supervise a small group of technicians during equipment installation, cable routing or system verification activities, ensuring adherence to safety protocols and manufacturer instructions.
- Manage job-site logistics such as tool availability, part storage, test equipment calibration and the preparation of job cards or work reports.
- Ensure proper documentation and traceability of work completed, including as-built records, test results, and compliance signoffs.
Example: Completing commissioning reports for a PLC-controlled batching system.
- Apply resource planning at a task level, matching technician skillsets to the job, checking tool readiness and confirming material availability before starting field work.
- Follow established engineering management practices, such as:
 - using checklists, job cards or work breakdown structures (WBS) to manage recurring or standardised activities
 - applying site safety and environmental procedures
 - Tracking work using spreadsheets, apps or CMMS (Computerised Maintenance Management Systems)
 - attending training to improve knowledge in areas such as basic project coordination, site safety leadership, vendor-specific commissioning procedures and field-level documentation.

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- Technicians are expected to:
 - implement and operate systems or components based on approved designs
 - solve routine or procedural problems under supervision or instruction
 - manage day-to-day execution of defined tasks
 - record and report progress and outcomes using structured formats.
- Applicants must show they:
 - understood the scope of their assigned tasks
 - planned and executed the work in a timely and organised manner
 - took responsibility for reporting issues and meeting task-level goals.

4.3.5 Outcome 5: Communicate clearly using multiple mediums and collaborate inclusively with a broad range of stakeholders in the course of engineering activities
(Responsibility level C)


This outcome requires Candidate Technicians to communicate clearly using multiple media and collaborate inclusively with a broad range of stakeholders in the course of their well-defined engineering activities. They should communicate effectively both orally and in writing, with engineering audiences and the community at large and convey information through oral, written and graphical techniques or a combination thereof, as well as collaborating with team members, clients and other stakeholders in their well-defined engineering activities. Professional communication is a vital skill for Applicant Engineering Technicians to possess since all their decisions are communicated to different parties.

The Applicant should develop the ability to:

- write clear, concise, effective and technically, legally and editorially correct reports using a structure and a style that meet communication objectives and user/audience requirements
- issue clear and concise instructions and/or guidance, being cognisant of the audience and various skill levels
- deliver structured oral presentations using appropriate language, visual aids and supporting materials for the intended audience and purpose.

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The Applicant should be able to perform the following activities, among others:


- Conduct effective meetings, working with people who are not technical, working with other cultures, issuing and receiving instructions, reporting on engineering works and sharing ideas.
- Train and draw, correct and revise drawings, compile test reports, use operation and maintenance manuals to write work procedures, write inspection and audit reports, write commissioning reports and prepare and present motivations for new projects.
- During the execution of engineering work activities, Engineering Technicians hold meetings and develop technical reports, tender document specifications and bills of quantity.
- Create presentations for colleagues, team members, supervisors and clients using visual aids and supporting documents.
- Prepare document software configuration steps or usage procedures for custom applications, embedded systems or diagnostic tools, including screenshots, setup notes and installation logs to support future maintenance or user training.
- Report software issues or unexpected behaviour encountered during testing, installation, or operation, clearly describing what happened, steps taken, observed system responses and any actions applied, using structured forms, checklists or ticketing systems.
- Develop effective communication skills during training and be able to demonstrate such skills to be registered as Professional Engineering Technicians.

4.3.6 Outcome 6: Recognise the reasonably foreseeable economic, social, cultural and environmental effects of well-defined engineering activities seeking to achieve sustainability (Responsibility level B)

This outcome requires Candidate Technicians to recognise the reasonably foreseeable economic, social, cultural and environmental effects of well-defined engineering activities seeking to achieve sustainability. The outcome requires Applicants to recognise and address the impact of their well-defined defined engineering activities on these components and where there are negative effects, provide mitigating measures.

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Risk and impact mitigation must include the probability and impact of all the risks connected with the project. The risk document must be a live document through the life cycle of a project and may include technical risk, environmental risk, quality risk, commercial risk, schedule risk, social risk, cultural risk and construction risk. Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs, and press releases.

The Applicant should develop the ability to:


- identify interested and affected parties and their expectations with regard to technical, sociocultural and environmental effects, while considering the economics and long-term sustainability of the well-defined engineering activities
- recognise and address the impact of their well-defined engineering activities on social, cultural and environmental components
- identify the risk negative impact of the well-defined engineering activities on the components and develop plans and measures to mitigate the negative effects of well-defined engineering activities
- integrate sustainability and ethics into the decision-making process throughout the project lifecycle.

The Applicant should be able to perform the following activities, among others:

- Have an understanding and working knowledge of the impact of engineering work on social effects and be able to provide mitigation measures to affected parties. Social effects encompass all issues that affect people and their livelihood, directly or indirectly. Engineering activities may affect people's way of life, political system, health and wellbeing, and personal and property rights.
- Have an understanding and working knowledge of the impact of engineering work on cultural effects and be able to provide mitigation measures to affected parties. Cultural effects include people's customary beliefs, religion, language and norms, for example ceremonies and customs of a particular group or society.
- Have an understanding and working knowledge of the impact of engineering work on environmental effects and be able to provide mitigation measures to affected parties.

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Environmental effects include people's environment, namely air and water quality, dust and exposure to noise and adequacy of sanitation, as well as large ecosystems. This might include disruption of ecosystems, fauna and flora and increased land temperatures and impact on historical buildings.

- Have an understanding of and develop risk and impact mitigation measures that include the probability and impact of all the risks connected with the project. Mitigating measures taken can involve environmental impact studies, environmental impact management, community involvement and communication, barricades, warning signs, press releases, etc.

4.3.7 Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons during all well-defined engineering activities (Responsibility level E)


This outcome requires Candidate Technicians to develop a working knowledge of the related regulations and Acts and demonstrate how this legislation affects their well-defined engineering activities. They are required to meet all legal and regulatory requirements and protect the health and safety of persons during all well-defined engineering activities.

All engineering work must be carried out in accordance with the norms of the profession. Such norms are generally represented by national and international standards, industry standards, codes of practice and best practice guidelines. Candidates are expected to have a basic knowledge of the applicable Acts applicable to their area of practice. The list of common Acts and regulatory standards, among others in the Computer Engineering profession is below.

- Engineering Profession Act, 46 of 2000
- Occupational Health and Safety Act, 85 of 1993
- National Building Regulations and Building Standards Act, 103 of 1977
- National Environmental Management Act, 107 of 1998
- Employment Equity Act, 55 of 1998
- Mine Health and Safety Act, 29 of 1996
- Occupational Health and Safety Act, 85 of 1993 and Regulations
- Specific work instructions, standards, and/or specifications of the enterprise
- Protection of Personal Information Act, 4 of 2013

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- Specific work instructions, standards and/or specifications of the enterprise.

Other Acts not listed here may also be pertinent to a Candidate's specific work environment. Applicants are expected to have a basic knowledge of the relevant Acts and to investigate whether any Acts are applicable to their particular work environment.

The Applicant should develop the ability to:


- identify applicable legal, regulatory, health and safety regulations requirements and standards for the well-defined engineering activity
- apply health and safety regulations and ensuring the safety of all affected persons through the use of safe and sustainable materials, components, processes and systems for the well-defined engineering activity
- identify risks and risk management strategies for the well-defined engineering activity.

The Applicant should be able to perform the following activities, among others:

- Have a working knowledge of the related regulations and Acts and be able to identify and demonstrate how this legislation affects their well-defined engineering activities at the requisite responsibility level. They should also have a basic knowledge of the relevant Acts and investigate whether any Acts are applicable to their work environment. They should further have a working knowledge and familiarity with field-specific, industry-specific regulations and requirements practices in the South African industry. The industry-specific regulations and requirements may or may not be applicable in all fields of Computer Engineering.
- Have a working knowledge and functional understanding of the provisions of the OHS Act and/or the MHS Act in their specific workplaces. Activities include conducting regular health and safety assessments to identify and address workplace hazards, providing training and education on occupational health and safety practices to employees; ensuring compliance with regulations related to noise exposure, hazardous substances and ergonomics; and establishing incident reporting and investigation procedures to identify the root causes and prevent future occurrences and implementing measures to prevent work-related injuries and illnesses, such as proper ergonomics, regular breaks and medical surveillance programmes.

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- Demonstrate awareness and working knowledge of health and safety regulations. This could involve implementing safety protocols, conducting risk assessments and ensuring compliance with relevant safety standards. Examples could include implementing a safety management system to identify and mitigate Computer Engineering risks, regularly inspecting and maintaining equipment and infrastructure to ensure their safe operation, providing workers with appropriate PPE and ensuring its proper use, conducting safety training programmes for employees to enhance their awareness and knowledge of safety procedures or establishing emergency response plans and conducting drills to prepare for potential accidents or incidents.
- Demonstrate awareness and have a working knowledge and functional understanding of risks and risk management strategies associated with Computer Engineering activities. This could involve implementing safety measures, conducting hazard analyses and developing emergency response plans.

4.3.8 Outcome 8: Conduct engineering activities ethically (Responsibility level E)


This outcome requires Candidate Technicians to conduct themselves in an ethical manner, always demonstrating professionalism during the course of their *well-defined* engineering activities. They should conduct engineering activities ethically. Applicants should be capable of handling ethical issues and adopting a systematic approach to resolve ethical issues. Unethical behaviour may be in the form of fraud, corruption, maladministration or illegal activities.

The Applicant should develop the ability to:

- identify ethical problems, affected parties and the best solution to resolve the problem
- understand and apply ECSA's Rules of Conduct, a listing of ethics regarding integrity and competency; in addition, Applicants should have knowledge of the ECSA Code of Conduct with an understanding of how it relates to their area of practice
- pay attention to the health and safety of persons, area of competency, truth, integrity and honest behaviour as it is of paramount importance.

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Applicant Computer Engineering Technicians must perform engineering work and make technical decisions while adhering to the ECSA Code of Conduct for registered persons. The following factors should be considered when performing engineering work:

- Make decisions within the limits of the practitioner’s education, training and experience.
- Act with integrity and in accordance with the general norms of professional conduct.
- Strive to respect the interests of the public and health and safety and minimise environmental impact.
- If the scope of work falls outside the area of Applicant Computer Engineering Technicians’ expertise, they should seek guidance from relevant parties. Conflict of interest while conducting engineering activities should be avoided or declared so that decisions are made transparently.


4.3.9 Outcome 9: Exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of well-defined engineering activities (Responsibility level E)

This outcome requires Engineering Technicians to exercise sound judgement by evaluating the outcomes, impacts and alternatives in the course of well-defined engineering activities that can be solved mainly by practical engineering knowledge underpinned by related theory. Judgement is made in choosing and applying the appropriate standards, codes and documented procedures. Judgement is expected in considering interactions among methods, techniques and procedures and their immediate impact on affected parties in making recommendations.

The Applicant should develop the ability to:

- develop options and final solutions or approaches that consider defined issues that are concrete and largely complete but require checking and possible supplementation, a few conflicting constraints and the need for sustainability
- take a view of the solution while considering local risks, their consequences and the implications for a limited range of stakeholders and other affected parties.

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The Applicant should be able to perform the following activities, among others:

- Identify and evaluate the technical risk during the acquisition of new product or equipment and when considering the acquisition of any new technologies to solve well-defined problems.
- Conduct risk analysis to identify and mitigate risks for the acquisition, build, implementation, application, security, technical, operational and support of new or design changes that may result in performance degradation, security breaches, system failures, increased maintenance time and significant amount of technical debt for the organisation.
- Implement and maintain a reliable analysis solution for technical-risk management to ensure early detection of problems.
- Evaluate risk situations using risk management and decision-making tools and techniques.
- Generate documentary proof that a thorough investigation, analysis and identification have taken place and that the risks associated with certain decisions have been understood and mitigated.
- Demonstrate knowledge and understanding of the government legislation and regulations, organisational risk policies and local and international standards.
- Identify or demonstrate that risks are evaluated under one or more practice areas, such as engineering systems design, planning and directing the development, construction, implementation and operation of computer, automation, cyber security, software systems, network, telecommunication and instrumentation hardware equipment and components.
- Using a new product or different product to solve a well-defined engineering problem, develop a risk analysis template to identify and mitigate risks for the design, build, implementation, application, security, technical, operational and support of changes that may result in performance degradation, security breaches, system failures, increased maintenance time and significant amount of technical debt for the organisation.
- Demonstrate how risk identification techniques such as Brainstorming, SWOT Analysis, Delphi Technique and Root Cause Analysis, among others, have been used to evaluate a well-defined engineering problem.

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- Demonstrate how risk analysis and assessment techniques such as Risk Matrix (Probability and Impact Matrix), Decision Tree, Failure Modes and Effects Analysis (FMEA) and Bowtie Modelling, among others, have been used to assess a well-defined engineering problem.
- Demonstrate how risk response planning techniques such as Risk Avoidance, Risk Mitigation, Risk Transfer and Risk Acceptance, among others, have been used to respond to a well-defined engineering problem.
- Demonstrate how risk monitoring and control techniques such as Risk Register, Risk Reassessment and Risk Audits, among others, have been used to monitor and control a well-defined engineering problem.
- Undergo training courses in risk identification, techniques, planning, analysis, assessment, response, monitoring, control and legislation, among others.


4.3.10 Outcome 10: Be responsible for making decisions on part or all of well-defined engineering activities (Responsibility level E)

This outcome requires Engineering Technicians to be responsible for making decisions on part or all of *well-defined engineering activities* that can be solved mainly by practical engineering knowledge underpinned by related theory. Having the practical engineering knowledge and operating on Level E of Degree of Responsibility affords Candidates an opportunity to demonstrate how they were able to make decisions and take on responsibility for significant parts of one or more well-defined engineering activities. Engineering technicians are responsible for making decisions on part, or all of well-defined engineering activities.

Responsible decision-making is typified by the systematic gathering of related information and checking of the facts and inputs required for the decision-making process. Engineering Technicians need to make the final decision, based on knowledge, past experience and seeking advice on matters falling outside the Engineering Technician's education and experience. Seeking advice or guidance from the relevant superiors assists Applicants to make informed decisions and assume responsibility for those decisions.

Engineering Technicians must keep a detailed record of the decision-making process and the reasons for the final decision. Engineering Technicians need to take responsibility and be

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prepared to be held accountable for the local consequences (positive or negative).

The Applicant should develop the ability to:


- systematically gather related information and check facts and inputs required for the decision-making process
- make the final decision, based on practical knowledge, past experience and seeking advice on matters falling outside the Applicant's education and experience
- record the decision-making process and the reasons for the final decision
- take responsibility and be prepared to be held accountable for locally important but not far-reaching consequences (whether positive or negative).

The Applicant should be able to perform the following activities, among others:

- Identify and evaluate how technical risk of a design can negatively impact the project, system or entire infrastructure if the implementation is not successful as anticipated.
- In developing practical engineering solutions, demonstrate by keeping and collating documents, records and decision registers, the factors taken into consideration during decision-making, bearing in mind risk, consequences in technology application and locally affected parties.
- Technicians must support Disaster Recovery (DR) and Business Continuity (BCP) efforts by ensuring that installations and system configurations follow established procedures for data backup, failover and recovery. They must be aware of the operational impact of downtime and apply defined recovery processes in line with safety, quality and maintenance protocols.
- Develop a decision-making template to demonstrate how applying engineering knowledge acquired from relevant academic institutions and accredited engineering programmes can be used to make effective decisions in solving well-defined engineering problems.
- Expand the decision-making template to include considerations from a limited range of interested and affected parties with defined issues, considering a few conflicting constraints and the need for sustainability.
- Demonstrate how one or more decision-making tools and techniques such as Decision Matrix, Pros/Cons Lists, Decision Tree, Cost-Benefit Analysis, Multi-voting Technique,

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Influence Diagram, Trial and Error, Pareto Analysis, SWOT Analysis, PEST Analysis, Feasibility Study and Kepner-Tregoe Method, among others, have been used to make decisions for a complex engineering problem.

- Attend decision-making training courses to gain familiarity with decision-making tools and techniques.

4.3.11 Outcome 11: Undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work (Responsibility level D)

This outcome requires Engineering Technicians to undertake sufficient professional development activities to maintain, extend competence and enhance the ability to adapt to emerging technologies and the ever-changing nature of work. Engineering Technicians need to undertake CPD activities to maintain and extend their competencies. Engineering Technicians need to be able to explain awareness and a strategy to independently enhance professional development. Engineering Technicians need to collect evidence of self-development in their chosen and new areas of expertise and personal development. Professional development involves taking ownership and independently planning, selecting, undertaking and recording appropriate activities to extend competence.


Record-keeping must not be left to the employer or anybody else. Trainees must manage their own training independently by taking initiative and being in charge of experiential development towards the level of Professional Technician.

The Applicant should develop the ability to:

- explain awareness and a strategy to independently enhance professional development
- provide evidence of self-development in chosen and new areas of expertise and personal development
- demonstrate the strategy to identify new and emerging technologies, concepts and tools
- demonstrate the strategy to incorporate identified new and emerging technologies in self-development activity planning
- demonstrate the process for record-keeping of self-development activities.

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The Applicant should be able to perform the following activities, among others:

- Attend work, engineering and industry related learning and training activities in the following areas among others:
 - Project management such as PMBOK or PRINCE, Conditions of Contract / Value Engineering – New Engineering Contract (NEC), Joint Building Contract Committee (JBCC), etc, hardware, software, data modelling and cyber security concepts and standards (MESA, ISA, IEEE, IEC etc), hardware and software systems architecture models and standards (RAMI 4.0, Zachman Framework, OMAC [Organisation for Machine Automation and Control], SCOR [Supply Chain Council], OAGIS [Open Application Group for Industry], OPC Unified Architecture [OPC Foundation], Condition Based Operations [MIMOSA]), hardware and software specifications, business analysis, business process modelling tools and techniques and preparation of specifications, negotiation skills, process optimisation and continuous improvement concepts, tools and techniques (6 Sigma, TQM, Lean, JIT 5S, etc), engineering finance, risk analysis, HAZOP study methods and techniques, quality systems and standards, occupational health and safety, computer health and safety, food safety and hygiene (Hazard Analysis & Critical Control Points), engineering ethics, discipline-specific courses, energy efficiency, maintenance engineering, environment impacts, people management, finance management, report writing, planning methods and tools, system engineering, industrial relations and public speaking. etc
- Training and courses that do not carry official CPD points are also appropriate, such as courses or training offered within the employer organisation or by other organisations.

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5. FUNCTIONS PERFORMED

Computer Engineering forms an integral part of the broader engineering systems and infrastructure in technologically complex manufacturing, processing, mining, construction, product development and research environments. Special consideration in the discipline, subdiscipline or specialty must be given to the competencies specified in the following groups:

- Knowledge-based problem-solving (this should be a strong focus)
- Management and communication
- Identifying and mitigating the impacts of engineering activity
- Judgement and responsibility
- Independent learning.

5.1 Degrees of Responsibilities


The increase in the DoR that Applicants experience during their professional training is presented in document **R-04-T&M-Guide-PC** and **Table 1**. It reflects the nature of the work, specific examples and outcomes appropriate to training in Computer Engineering.

Table 1 – Applicant’s Progression through DoR

Degree of Responsibility	Nature of work	Activities/duties to be undertaken during training
A: Being Exposed	The Applicant undergoes induction and observes processes and work of competent practitioners.	<ul style="list-style-type: none"> • Understand the business environment and the dynamics that shape the businesses and industries in which they operate. • Understand the business model, its key processes and critical outcomes. • Understand the value added by Computer and other Engineering Professionals in the business.
B: Assisting	The Applicant performs specific processes under close supervision.	<ul style="list-style-type: none"> • Develop insight and understanding of the different processes and systems in transforming inputs into goods and services. • Develop an appreciation of the resources available to Computer Engineering practitioners. • Obtain experience in the day-to-day operations of the business, with specific emphasis on productivity and quality measurements.

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Degree of Responsibility	Nature of work	Activities/duties to be undertaken during training
C: Participating	The Applicant performs specific processes as directed, with limited supervision.	<ul style="list-style-type: none"> Gain first-hand experience of a broad range of Computer Engineering activities (e.g., systems design and re-engineering, planning and control, work study, value engineering, materials and information management, people management, logistics, specialists' inputs, tools and equipment, and quality assurance). Note the problems and limitations of particular approaches, methods and techniques, with emphasis on cost/effort and relative benefit.
D: Contributing	The Applicant performs specific work with detailed approval of work outputs.	<ul style="list-style-type: none"> Be involved in activities such as the planning of production, control of quality and costs, materials handling and workplace layout, activity-based costing, benchmarking, business case evaluation, process re-engineering, maintenance practice and procedures, and project management and system specification. Of particular importance is the economical use of people, materials and machines. Give specific attention to human aspects concerning communication, interpersonal relationships and teamwork, training, cost analysis, cost control and profit accountability.
E: Performing	The Applicant works in a team without supervision, recommends work outputs and is responsible but not accountable.	<ul style="list-style-type: none"> Assume escalating technical responsibility and increased co-ordination of the work of others. Gain exposure to and develop skills in management areas such as labour relations, management accounting, business law and general business management, all of which are important for developing well-rounded Engineering Practitioners. Seek assignments that require judgement, even if full information is unavailable, which provide opportunities of professional responsibility.

Applicants working at Responsibility level E carry responsibility appropriate to that of a registered person, except that Applicants' Supervisors are accountable for their recommendations and decisions.

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5.2 Candidate training programmes

5.2.1 Leading practices

No ideal training programme structure or unique sequencing constitutes leading practice. The training programme for each Applicant depends on the available work opportunities at the time that the employer assigns to the Applicant.

It is suggested that Applicants work with their Supervisors and Mentors to determine appropriate projects to gain exposure to elements of the asset lifecycle and to ensure that their designs are constructable, operable and consider long-term costing and sustainability. A regular reporting structure should be in place, with suitable recording of evidence of achievement against the competency outcomes and levels of responsibility.

The training programme should enable the Applicant to progress through the levels of work capability described in **R-04-T&M-GUIDE-PC** so that, by the end of the training period, the Applicant exhibits a Level E DoR, where required, and is able to perform individually and as a team member at the level of problem-solving and engineering activity required for registration.

5.2.2 Realities


The minimum experience required by ECSA for registration in a Professional Category is 3 years after graduating with a recognised qualification, as stipulated in section 2 of this DSTG. The likelihood, however, is that the period of training will be longer, determined by the availability of opportunities and the exposure to various functions in the actual work environment.

Irrespective of the route followed, the overriding consideration is that the Applicant must provide evidence of competence against the standard and provide objective evidence of meeting the 11 outcomes described in **R-08-CS-GUIDE-PE/PT/PN**.

5.2.3 Generalists, specialists, researchers and academics

Document **R-08-CS-GUIDE-PE/PT/PN** adequately describes what is expected of persons whose formative development has not followed a conventional path, such as academics, researchers and specialists.

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Irrespective of the route followed, the overriding consideration is that the Applicant must provide evidence of competency against the standard.

5.2.4 Orientation requirements

For an Applicant starting a career with a company, the basic introduction to the company's functions is usually performed during the first months of employment. The induction process includes the following:

- Introduction to company safety regulations
- Code of conduct
- Staff code and regulations
- Typical functions and activities within the company
- Hands-on experience and orientation in each of the major divisions
- Overall company operations and company-related facilities.


5.3 Moving into or changing candidacy training programmes

This guide assumes that the Applicant enters a programme after graduation and continues with the programme until ready to apply for registration. It also assumes that the Applicant is supervised and mentored by persons who meet the requirements in document **R-04-T&M-GUIDE-PC**. In the case of a person changing from one candidacy programme to another or moving into a candidacy programme from a less structured environment, it is essential that the following steps are completed:

- The Applicant must complete the Training and Experience Summary (TES) and the Training and Experience Reports (TERs) for the previous programme or unstructured experience. In the latter case, it is important to reconstruct the experience as accurately as possible. The TERs must be signed off by the relevant Supervisor or Mentor.
- On entering the new programme, the Mentor and Supervisor should review the Applicant's development while mindful of past experience and opportunities and the requirements of the new programme. At a minimum, the Mentor and Supervisor should plan the next phase of the Applicant's programme.

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6. CONCLUSION

To attain registration in a professional category, Applicants should be able to meet the educational requirements for the category and demonstrate competency against the prescribed standards for the registration category. Demonstrating competency is achieved by meeting the requirements for the 11 ECSA outcomes. Applicants and their Supervisors and Mentors must ensure that the training provided is geared towards achieving the ECSA competency outcomes. Focusing on one training aspect for the entire duration of training will not assist Applicants to achieve the necessary skills to demonstrate all the standard competency outcomes.

Development of the training plan is the responsibility of the Applicant, who must ensure that it covers all aspects of the outcomes. It has been common practice that in situations where a department or organisation is unable to provide training in certain areas, secondments are arranged with other departments or organisations so that the Applicant is able to develop all the competencies required for registration. These secondments are usually reciprocal in nature and benefit both the employee and the employer. Secondments between consultants and contractors and between the public and private sectors should be possible to allow Applicants to acquire the necessary competencies.

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REVISION HISTORY

Revision number	Revision date	Revision details	Approved by
Rev 0 Draft A	11 April 2025	The DSTG has been merged into one Discipline-specific Training Guide for Registration as a Professional Engineer, Technologist and Technician in Industrial Engineering and to ensure that the DSTG clearly details how each outcome can be achieved.	RDDR BU
Rev 0 Draft B	30 June 2025	<p>The review has included an introduction section. The document further indicates the type of engineering work that the different categories should undertake.</p> <p>Section 4. Developing Competency: Document (R-08-PE/PT/PN) Under training for registration as a professional engineer, professional engineering technologist and professional engineering technician has been revised to ensure that each training element is aligned to each outcome,</p> <p><i>4.1.1 Investigation & Analysis</i> The content under this section is aligned with Outcome 1</p> <p><i>4.1.2 Engineering Design & Development of solution</i> The content under this section is aligned with Outcome 2</p> <p><i>4.1.3 Contextual Knowledge</i> The content under this section is aligned with Outcome 3</p> <p><i>4.1.4 Engineering Project Management</i> The content under this section is aligned with Outcome 4</p> <p><i>4.1.5 Professional Communication</i></p>	Working group

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Revision number	Revision date	Revision details	Approved by
		<p>The content under this section is aligned with Outcome 5</p> <p><i>4.1.6 Impact of Engineering Activities & Risk Mitigation</i></p> <p>The content under this section is aligned with Outcome 6</p> <p><i>4.1.7 Statutory & Regulatory Requirements</i></p> <p>The content under this section is aligned with Outcome 7</p> <p><i>4.1.8 Ethics of Engineering</i></p> <p>The content under this section is aligned with Outcome 8</p> <p><i>4.1.9 Exercising sound judgment</i></p> <p>The content under this section is aligned with Outcome 9</p> <p><i>4.1.10 Responsibility in Decision-making</i></p> <p>The content under this section is aligned with Outcome 10</p> <p><i>4.1.11 Professional Development</i></p> <p>The content under this section is aligned with Outcome 11</p>	
Rev 0 Draft C	01 July 2025	Document revised with WG and sent to Registration BU for inputs and comments	RI BU, Registration BU and WG
Rev 0 Draft D	22 July 2025	Document submitted to the IEA Task Team for alignment to the IEA changes	IEA Review Task Team
Rev 0 Draft E	5 September 2025	Reviewed and checked	Acting Executive: RSIR
Rev 0	19 September 2025	Approval	RPSC

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The Discipline-specific Training Guide for

Registration as a Professional Engineer, Technologist and Technician in Computer Engineering

Revision 0 dated 19 September 2025 and consisting of 100 pages reviewed for adequacy by the Business Unit Assistant Manager and is approved by the Acting Executive: Regulatory Services & International Relations (**ERSIR**).



 Business Unit Assistant Manager

7 October 2025

 Date



 Acting Executive: RSIR


7 October 2025

 Date

This definitive version of this policy is available on our website

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APPENDIX A: TRAINING ELEMENTS

Synopsis: Applicants should achieve specific competencies at the prescribed level during their development towards professional registration, at the same time accepting more and more responsibility as experience is gained. The outcomes achieved and established during the candidacy phase should form the template for all engineering work performed after professional registration regardless of the level of responsibility at any particular stage of an engineering career:


1. Confirm understanding of instructions received and clarify if necessary.
2. Use theoretical training to develop possible solutions: select the best and present to the recipient.
3. Apply theoretical knowledge to justify decisions taken and processes used.
4. Understand role in the work team and plan and schedule work accordingly.
5. Issue complete and clear instructions and report comprehensively on work progress.
6. Be sensitive about the impact of the engineering activity and take action to mitigate this impact.
7. Consider and adhere to legislation applicable to the task and the associated risk identification and management.
8. Adhere strictly to high ethical behavioural standards and ECSA's Code of Conduct.
9. Display sound judgement by considering all factors, their interrelationship, consequences and evaluation when all evidence is not available.
10. Accept responsibility for own work by using theory to support decisions, seeking advice when uncertain and evaluating shortcomings.
11. Become conversant with your employer's training and development programme and develop your own lifelong development programme within this framework.

Complex, broadly defined and well-defined engineering work is usually characterised by the application of engineering deviating from standard procedures, codes and systems, the deviation verified by research, modelling and/or substantiated design calculations.

Responsibility Levels: A = Being Exposed; B = Assisting; C = Participating; D = Contributing; E = Performing.

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Competency Standards for Registration as a Professional Engineering Technologist	Explanation and Responsibility Level
<p>1. Purpose</p> <p>This standard defines the competence required for registration as a Professional Engineer, Technologist and Technician. Definitions of terms having particular meaning within this standard is given in text in relevant section.</p>	<p>DSTGs give context to the purpose of the Competency Standards. The Engineer, Technologist and Technician operate within the 12 disciplines ECSA recognises. Each discipline can be further divided into sub-disciplines and finally into specific workplaces as given in section 4 of the specific DSTG. <u>DSTGs are used to facilitate experiential development towards ECSA registration and assist in compiling the required portfolio of evidence (specifically the Engineering Report in the application form).</u></p> <p>NOTE: The training period must be used to develop the trainee's competence towards achieving the standards below at a Responsibility Level E, i.e., Performing. (Refer to the specific DSTG)</p>
<p>2. Demonstration of competence</p> <p>Competence must be demonstrated within Complex, broadly defined and Well-defined <i>engineering activities</i>, defined below, by integrated performance of the outcomes defined at the level defined for each outcome. Required contexts and functions may be specified in the applicable DSTG.</p> <p>Level Descriptor: Complex engineering activities (CEA), broadly defined engineering activities (BDEA), and well-defined engineering activities (WDEA) have several of the following characteristics:</p> <p>a) Scope of practice area is linked to technologies used and changes by adoption of new technology into current practice.</p> <p>b) Practice area is located within a wider, complex context, requires teamwork, and has interfaces with other parties and disciplines.</p>	<p>Engineering activities can be divided into (approximately):</p> <ul style="list-style-type: none"> 5% Complex (Professional Engineers) 5% Broadly Defined (Professional Engineering Technologists) 10% Well-defined (Professional Engineering Technicians) 15% Narrowly Well-defined (Registered Specified Categories) 20% Skilled Workman (Engineering Artisan) 55% Unskilled Workman (Artisan Assistants) <p>Activities can be in-house or contracted out; evidence of integrated performance can be submitted irrespective of the situation.</p> <p>Level Descriptor: CEA, BDEA and WDEA in the various disciplines are characterised by several or all the following:</p> <p>a) Scope of practice area does not cover the entire field of the discipline (exposure limited to the sub-discipline and specific workplace). Some technologies used are well established and adoption of new technologies needs investigation and evaluation.</p> <p>b) Practice area varies substantially with unlimited location possibilities and an additional responsibility to identify the need for advice on CEA, BDEA and WDEA activities and problems. CEA, BDEA and WDEA</p>

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<p>c) Involves a variety of resources, including people, money, equipment, materials and technologies.</p> <p>d) Requires resolution of occasional problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues.</p> <p>e) Are constrained by available technology, time, finance, infrastructure, resources, facilities, standards and codes and applicable laws.</p> <p>f) Have significant risks and consequences in the practice area and in related areas.</p>	<p>activities in the sub-discipline needs interfacing with professional engineers, professional technicians, artisans, architects, financial staff, etc. as part of the team.</p> <p>c) The bulk of the work involves familiar, defined range of resources, including people, money, equipment, materials, but new technologies are investigated and implemented.</p> <p>d) Most of the impacts in the sub discipline are on wider issues, but some arise from conflicting technical and engineering issues that have to be addressed by the application of broadly defined non-standard engineering principles.</p> <p>e) The work packages and associated parameters are constrained by operational context with variations limited to different locations only. (Cannot be covered by standards and codes.)</p> <p>f) Even locally important minor risks can have far reaching consequences.</p>
<p>Activities include but are not limited to design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; manufacture or construction; engineering operations; maintenance; project management; research; development and commercialisation.</p>	<p>Activities include but are not limited to design; planning; investigation and problem resolution; improvement of materials, components, systems or processes; engineering operations; maintenance; project management. For Engineers, Technologists and Technicians, research, development and commercialisation happen more frequently in some disciplines but are seldom encountered in others.</p>
3. Outcomes to be satisfied:	Explanation and Responsibility Level
Group A: Engineering Problem Solving	
<p>Outcome 1: Define, investigate and analyse <i>complex, broadly defined and well-defined</i>, engineering problems</p>	<p>Responsibility Level E Analysis of an engineering problem means the 'separation into parts possibly with comment and judgement'. <i>complex, broadly, well-defined</i> means: 'not minute or detailed' and 'not kept within narrow limits'.</p>
<p>Complex, broadly defined and well-defined engineering problems have the following characteristics.</p> <p>a) They require coherent and detailed engineering knowledge, underpinning the technology area; <i>and one or more of the following:</i></p>	<p>a) Coherent and detailed engineering knowledge for Engineer, Technologist and Technician means the problem encountered cannot be solved without the combination of all the relevant detail including engineering principles applicable to the situation.</p>

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<ul style="list-style-type: none"> b) Are ill-posed, under- or over-specified, require identification and interpretation into the technology area. c) Encompass systems within complex engineering systems; d) Belong to families of problems which are solved in well-accepted but innovative ways. <i>and one or more of:</i> e) Can be solved by structured analysis techniques f) May be partially outside standards and codes; must provide justification to operate outside. g) Require information from practice area and sources interfacing with practice area that is complex and incomplete. h) Involve a variety of issues which may impose conflicting constraints: technical, engineering and interested or affected parties. <i>and one or both of:</i> i) Require judgement in decision-making in practice area, considering interfaces to other areas. j) Have significant consequences which are important in practice area but may extend more widely. 	<ul style="list-style-type: none"> b) The nature of the problem is not immediately obvious, and further investigation to identify and interpret the real nature of the problem is necessary. c) The problem is not easily recognised as part of the larger engineering task, project or operation and may be obscured by the complexity of the larger system. d) It is recognised that the problem can be classified as a falling within a typical solution requiring innovative adaptation to meet the specific situation. e) Solving the problem needs a step-by-step approach adhering to proven logic. f) The standards, codes and documented procedures must be analysed to determine to what extent they are applicable to solve the problem, and justification must be given to operate outside these. g) The responsibility lies with the Engineer, Technologist and Technician to verify that some information received as part of the problem encountered may remain incomplete and solutions to problems may need justified assumptions. h) The problem handled by Engineer, Technologist and Technician may be solved by alternatives that are unaffordable, detrimental to the environment, socially unacceptable, not maintainable, not sustainable, etc; the Engineer, Technologist and Technician will have to justify his/her recommendation. i) Practical solutions to problems include knowledge and judgement of the roles displayed by the multi-disciplinary team and impact of own work in the interactive environment. j) The Engineer, Technologist and Technician must realise that their actions might seem to be of local importance only but may develop into significant consequences extending beyond their own ability and practice area.
<p>Assessment criteria: A structured analysis of broadly defined problems typified by the following performances is expected:</p> <p>1.1 Performed or contributed to defining engineering problems leading to an agreed definition of the problems to be solved.</p>	<p>To perform an engineering task an Engineer, Technologist and Technician will typically receive an instruction from a senior person (customer) to do a specific task, and must:</p> <p>1.1 Ensure the instruction is complete, clear and within his/her capability and that the person who issued the instruction agrees with his/her interpretation.</p>

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1.2 Performed or contributed to investigating engineering problems including collecting, organising and evaluating information.	1.2 Ensure the engineering problem and related information are segregated from the bulk of the information, investigated and evaluated.
1.3 Performed or contributed to analysis of engineering problems using conceptualisation, justified assumptions, limitations and evaluation of results.	1.3 Ensure that the instruction and information to do the work is fully understood and complete, including engineering theory needed to understand the task and acceptance criteria, and to carry out and/or check calculations. If needed supplementary information must be gathered, studied and understood. Concepts and assumptions must be justified by engineering theory and calculations, if applicable.
3. Outcomes to be satisfied:	Explanation and Responsibility Level
Range statement: The problem may be a design requirement, an applied research and development requirement or a problematic situation in an existing component, system or process. The problem is one amenable to solution by technologies known to the Candidate. This outcome is concerned with the understanding of a problem: Outcome 2 is concerned with the solution.	Please refer to section 4 of the specific DSTG.
Outcome 2: Design or develop solutions to complex, broadly defined and well-defined engineering problems	Responsibility Levels C and D Design means 'drawing or outline from which something can be made'. Develop means 'come or bring into a state in which it is active or visible'.
Assessment criteria: This outcome is normally demonstrated after a problem analysis as defined in Outcome 1. Working systematically to synthesise a solution to a broadly defined problem, typified by the following performances is expected: 2.1 Designed or developed solutions to complex, broadly defined and well-defined engineering problems. 2.2 Systematically synthesised solutions and alternative solutions or approaches to the problem by analysing designs against requirements, including costs and impacts on outside parameters. (requirements).	After the task received is fully understood and interpreted, a solution to the problem posed can be developed (designed). To synthesise a solution is 'the combination of separate parts, elements, substances, etc. into a whole or into a system' by the following: 2.1 The development (design) of more than one way to solve an engineering task or problem should always be done, including the costing and impact assessment for each alternative. All the alternatives must meet the requirements set out by the instruction received, and the theoretical calculations to support each alternative must be done and submitted as an attachment. 2.2 The Engineer, Technologist and Technician will in some cases be unable to support proposals with the complete theoretical calculation to substantiate every aspect and must in these cases refer his / her alternatives to an engineer for scrutiny and support. The alternatives and alternative recommended must be convincingly

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2.3 Drawing up of detailed specification requirements and design documentation for implementation to the satisfaction of the client.	<p>detailed to win customer support for the alternative recommended. Selection of alternatives might be based on tenders submitted with alternatives deviating from those specified.</p> <p>2.3 The best complete and final solution selected must be followed up with a detailed technical specification, supporting drawings, bill of quantities, etc. for the execution of work to meet customer requirements.</p>
Range Statement: Solutions are those enabled by the technologies in the Candidate's practice area.	Applying theory to do complex, broadly defined and well-defined engineering work is mostly done in a way that has been used before, probably developed by engineers in the past, and documented in written procedures, specifications, drawings, models, examples, etc. The Engineer, Technologist and Technician must seek approval for any deviation from these established methods but must also initiate and/or participate in the development and revision of these norms.
Outcome 3: Comprehend and apply the knowledge embodied in widely accepted and applied engineering procedures, processes, systems or methodologies and those specific to the jurisdiction in which he/she practices.	Responsibility Level E Comprehend means 'to understand fully'. The jurisdiction in which an Engineer, Technologist and Technician practices is given in section 4 of the specific DSTG.
<p>Assessment criteria: This outcome is normally demonstrated in the course of design, investigation or operations.</p> <p>3.1 Apply engineering principles, practices, technologies, including the application of, B Eng, BTech or B Eng (Tech) and N Dip, theory in the practice area.</p> <p>3.2 Indicate working knowledge of areas of practice that interact with practice area to underpin teamwork.</p> <p>3.3 Apply related knowledge of finance, statutory, safety and management.</p>	<p>Design work for Engineer, Technologist and Technician is based on B Eng, BTech, N Dip, theory and is mostly the utilisation and configuration of manufactured components and selected materials and associated novel engineering., Engineer, Technologist and Technician develop and apply codes and procedures in their design work. Investigation would be on broadly defined incidents and condition monitoring, and operations mostly on developing and improving engineering systems and operations.</p> <p>3.1 Calculations at B Eng, BTech or B Eng (Tech) and/or NDip, theoretical level confirming the correct application and utilisation of equipment, materials and systems listed in section 4 of the specific DSTG must be done on broadly defined activities.</p> <p>3.2 The understanding of complex, broadly defined, well defined, procedures and techniques must be based on fundamental mathematical, scientific and engineering knowledge, as part of personal contribution within the engineering team.</p> <p>3.3 The ability to manage the resources within legal and financial constraints must be evident.</p>

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<p>Range Statement: Applicable knowledge includes:</p> <p>a) Technological knowledge that is well-established and applicable to the practice area irrespective of location, supplemented by locally relevant knowledge, for example, established properties of local materials. Emerging technologies are adopted from formulations of others.</p> <p>b) A working knowledge of interacting disciplines (engineering and other) to underpin teamwork.</p> <p>c) Jurisdictional knowledge includes legal and regulatory requirements as well as locally relevant codes of practice. As required for practice area, a selection of law of contract, health and safety, environmental, intellectual property, contract administration, quality management, risk management, maintenance management, regulation, project and construction management.</p>	<p>a) The specific location of a task to be executed is the most important determining factor in the layout design and utilisation of equipment. A combination of educational knowledge and practical experience must be used to substantiate decisions taken including a comprehensive study of systems, materials, components and projected customer requirements and expectations. New ideas, materials, components and systems must be investigated, evaluated and applied accompanied by complex theoretical motivation.</p> <p>b) In spite of having a working knowledge of interacting disciplines, Engineer, Technologist and Technician take responsibility for the multidisciplinary team of specialists like Civil Engineers on structures and roads, Mechanical Engineers on fire protection equipment, architects on buildings, Electrical Engineers on communication equipment, etc.</p> <p>c) Jurisdictional in this instance means 'having the authority', and Engineer, Technologist and Technician must be aware of and decide on the relevant requirements applicable to each specific project that he/she is responsible for. They are usually appointed as the 'responsible person' for specific projects in terms of the OHS Act.</p>
Group B: Managing Engineering Activities	Explanation and Responsibility Level
<p>Outcome 4: Manage part or all of one or more complex, broadly defined and well-defined engineering activities.</p>	<p>Responsibility Level D Manage means 'control'.</p>
<p>Assessment criteria: The Candidate is expected to display personal and work process management abilities:</p> <p>4.1 Managed self, people, work priorities, processes and resources in broadly defined engineering work.</p>	<p>In Engineering operations Engineer, Technologist and Technician are typically given the responsibility to carry out projects.</p> <p>4.1 Resources are usually subdivided based on availability and controlled by a work breakdown structure and scheduling to meet deadlines. Quality, safety and environment management are important aspects.</p>

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4.2 Role in planning, organising, leading and controlling broadly defined engineering activities evident.	4.2 The basic elements of managements must be applied to broadly defined engineering work.
4.3 Knowledge of conditions and operation of contractors and the ability.	4.3 Depending on the project, Engineer, Technologist and Technician can be the team leader, a team member, or can supervise appointed contractors. To achieve this, maintenance of relationships is important and must be demonstrated.
Outcome 5: Communicate clearly with others in the course of his/her broadly defined engineering activities.	Responsibility Level C
Assessment criteria: Demonstrates effective communication by: 5.1 Ability to write clear, concise, effective technical, legal and editorially correct reports shown. 5.2 Ability to issue clear instructions to stakeholders using appropriate language and communication skills evident. 5.3 Oral presentations made using structure, style, language, visual aids	Refer to Range Statement for Outcome 4 and 5 below. Presentation of point of view mostly occurs in meetings and discussions with immediate supervisor.
Range Statement for Outcomes 4 and 5: Management and communication in <i>complex, broadly defined and well-defined engineering</i> involves: a) Planning <i>complex, broadly defined and well-defined</i> activities b) Organising <i>complex, broadly defined and well-defined</i> activities c) Leading <i>complex, broadly defined and well-defined</i> activities d) Controlling <i>complex, broadly defined and well-defined</i> activities.	a) Planning means 'the arrangement for doing or using something, considered in advance' b) Organising means 'put into working order, arrange in a system, make preparations for' c) Leading means to 'guide the actions and opinions of, influence, persuade' d) Controlling means the 'means of regulating, restraining, keeping in order, check' The Engineer, Technologist and Technician write specifications for the purchase of materials and/or work to be done, recommendations on tenders received, place orders and variation orders, write work instructions, report on work done, draw, correct and revise drawings, compile test reports, use operation and maintenance manuals to write work procedures, write inspection and audit reports, write commissioning reports, prepare and present motivations for new projects, compile budget reports, report on

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	studies done and calculations carried out, report on customer requirements, report on safety incidents and risk analysis, report on equipment failure, report on proposed system improvement and new techniques, report on cost control, etc.
Group C: Impacts of Engineering Activity	Explanation and Responsibility Level
Outcome 6: Recognise the foreseeable social, cultural and environmental effects of complex, broadly defined and well-defined engineering activities generally	Responsibility level B Social means 'people living in communities; of relations between persons and communities'. Cultural means 'all the arts, beliefs, social institutions, etc. characteristic of a community'. Environmental means 'surroundings, circumstances, influences'.
Assessment criteria: This outcome is normally displayed in the course of analysis and solution of problems. The candidate typically shows: 6.1 Ability to identify interested and affected parties and their expectations in regard to interactions between technical, social, cultural and environmental considerations shown. 6.2 Measures taken to mitigate the negative effects of engineering activities evident.	6.1 Engineering impacts heavily on the environment, e.g., servitudes, expropriation of land, excavation of trenches with associated inconvenience, borrow pits, dust and obstruction, street and other crossings, power dips and interruptions, visual and noise pollution, malfunctions, oil and other leaks, electrocution of human beings, detrimental effect on animals and wildlife, dangerous rotating and other machines, demolishing of structures, etc. 6.2 Mitigating measures taken may include environmental impact studies, environmental impact management, community involvement and communication, barricading and warning signs, temporary crossings, alternative supplies (ring feeders and bypass roads), press releases, compensation paid, etc.
Outcome 7: Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his/her broadly defined engineering activities.	Responsibility level E
Assessment criteria: 7.1 Identified applicable legal and regulatory requirements including health and safety requirements for the engineering activity. 7.2 Circumstances stated where Applicant assisted in or demonstrated awareness of the selection of safe and	7.1 The OHS Act is supplemented by a variety of parliamentary acts, regulations, local authority by-laws, standards and codes of practice. Places of work might have standard procedures, instructions, drawings and operation and maintenance manuals available. These documents, depending on the situation (emergency, breakdown, etc.) are consulted before work is commenced and during the activity. 7.2 It is essential to attend a Risk Management (Assessment) course, and to investigate and study the materials, components and systems used in the workplace. The Engineer, Technologist and Technician

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sustainable materials, components and systems and have identified risk and applied risk management strategies.	seeks advice from knowledgeable and experienced specialists if the slightest doubt exist that safety and sustainability cannot be guaranteed.
<p>Range Statement for Outcomes 6 and 7: Impacts and regulatory requirements include the following:</p> <p>a) Requirements include both explicit regulated factors and those that arise in the course of particular work.</p> <p>b) Impacts considered extend over the lifecycle of the project and include the consequences of the technologies applied.</p> <p>c) Effects to be considered include direct and indirect, immediate and long-term related to the technology used.</p> <p>d) Safe and sustainable materials, components and systems.</p> <p>e) Regulatory requirements are explicit for the context in general.</p>	<p>a) The impacts will vary substantially with the location of the task, e.g., the impact of laying a cable or pipe in the main street of town will be entirely different to construction in a rural area. The methods, techniques or procedures will differ accordingly and may be complex. It is identified and studied by the Engineer, Technologist and Technician before starting the work.</p> <p>b) The Safety Officer and/or the Responsible Person appointed in accordance with the OHS Act usually confirms or checks that the instructions are in line with regulations. The Engineer, Technologist and Technician is responsible to see that this is done, and if not, establish which regulations apply, and ensure that they are adhered to. Usually, the people working on site are strictly controlled. W.r.t. health and safety, but the Engineer, Technologist and Technician checks that this is done, but may authorise unavoidable deviation after setting conditions for such deviations. Projects are mostly carried out where contact with the public cannot be avoided, and safety measures like barricading and warning signs must be used and maintained.</p> <p>c) Effects associated with risk management are mostly well known if not obvious, and methods used to address, clearly defined. Risks are mostly associated with elevated structures, subsidence of soil, electrocution of human beings and moving parts on machinery. The Engineer, Technologist and Technician needs to identify, analyse and manage any long-term risks and develop strategies to solve these by using alternative technologies.</p> <p>d) The safe and sustainable materials, components and systems must be selected and prescribed by the Engineer, Technologist and Technician or other professional specialists must be consulted. It is the responsibility of the Engineer, Technologist and Technician to use his/her knowledge and experience to confirm that prescriptions by others are correct and safe.</p> <p>e) Application of regulations associated with the particular aspects of the project must be carefully identified and controlled by the Engineer, Technologist and Technician.</p>

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Group D: Exercise judgment, take responsibility, and act ethically	Explanation and Responsibility Level
Outcome 8: Conduct engineering activities ethically.	Responsibility level E Ethically means 'science of morals; moral soundness'. Moral means 'moral habits; standards of behaviour; principles of right and wrong'.
Assessment Criteria: Sensitivity to ethical issues and the adoption of a systematic approach to resolving these issues is expected, typified by: 8.1 Conversance and operation in compliance with ECSA's Rules of Conduct for registered persons confirmed 8.2 How ethical problems and affected parties were identified, and the best solution to resolve the problem selected.	Systematic means 'methodical; based on a system'. 8.1 ECSA's Code of Conduct, as per ECSA's website, is known and adhered to. 8.2 Ethical problems that can occur include tender fraud, payment bribery, alcohol abuse, sexual harassment, absenteeism, favouritism, defamation, fraudulent overtime claims, fraudulent expenses claimed, fraudulent qualifications, misrepresentation of facts, etc.
Outcome 9: Exercise sound judgement in the course of complex, broadly defined and well-defined engineering activities	Responsibility level E Judgement means 'good sense: ability to judge'.
Assessment criteria: Judgement is displayed by the following performance: 9.1 Judgement exercised in arriving at a conclusion within the application of technologies and their interrelationship to other disciplines and technologies. 9.2 Factors taken into consideration given, bearing in mind, risk, consequences in technology application and affected parties.	9.1 The extent of a project given to a junior Engineer, Technologist and Technician is characterised by the several broadly defined and a few well-defined factors and their resulting interdependence. He/she will seek advice if educational and/or experiential limitations are exceeded. 9.2 Taking risky decisions will lead to equipment failure, excessive installation and maintenance cost, damage to persons and property, etc. Evaluation includes engineering calculations to substantiate decisions taken and assumptions made.
Range Statement for Outcomes 8 and 9: <i>Judgement</i> in decision-making involves:	In Engineering, about 5% of engineering activities can be classified as broadly defined where the Engineer, Technologist and Technician uses standard procedures, codes of practice, specifications, etc, but

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<p>a) taking several risk factors into account; or</p> <p>b) significant consequences in technology application and related contexts; or</p> <p>c) ranges of interested and affected parties with widely varying needs.</p>	<p>develops variations and completely unique standards when needed. Judgement must be displayed to identify any activity falling inside the broadly defined range, as defined above:</p> <p>a) Getting the work done in spite of numerous risk factors needs good judgement and substantiated decision-making.</p> <p>b) Consequences are part of the project e.g., extra cost due to unforeseen conditions, incompetent contractors, long-term environmental damage, etc.</p> <p>c) Interested and affected parties with defined needs that may be in conflict, e.g., need for a service irrespective of environmental damage, local traditions and preferences, etc. needs sound management and judgement.</p>
<p>Outcome 10:</p> <p>Be responsible for making decisions on part or all of all of one or more complex, broadly defined and well-defined engineering activities</p>	<p>Responsibility level E</p> <p>Responsible means 'legally or morally liable for carrying out a duty; for the care of something or somebody in a position where one may be blamed for loss, failure, etc.'</p>
<p>Assessment criteria: Responsibility is displayed by the following performance:</p> <p>10.1 Engineering, social, environment and sustainable development taken into consideration in discharging responsibilities for significant parts of one or more activities.</p> <p>10.2 Advice sought from a responsible authority on matters outside your area of competence.</p> <p>10.3 Academic knowledge of at least B Eng, BTech N Dip, level combined with past experience used in formulating decisions.¹</p>	<p>10.1 All interrelated factors taken considered are indicative of professional responsibility accepted working on broadly defined activities.</p> <p>10.2 The Engineer, Technologist and Technician does not operate on tasks at a higher level than, complex, broadly defined, well defined and consults professionals at engineer level if elements of the project to be done are beyond his/her education and experience, e.g., power system stability.</p> <p>10.3 This is in the first instance continuous self-evaluation to ascertain that the task given is done correctly, on time and within budget. Continuous feedback to the originator of the task instruction and corrective action, if necessary, forms an important element. The calculations, for example fault levels, load calculations, losses, etc. are done to ensure that the correct material and components are utilised.</p>
<p>Range Statement: Responsibility must be discharged for significant parts of one or more complex, broadly defined and well-defined engineering activity.</p>	<p>The responsibility is mostly allocated within a team environment with an increasing designation as experience is gathered.</p>

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Note 1: Demonstrating responsibility is under supervision of a competent engineering practitioner but is expected to perform as if he/she is in a responsible position.	
Group E: Initial Professional Development (IPD)	Explanation and Responsibility Level
Outcome 11: Undertake independent learning activities sufficient to maintain and extend his or her competence.	Responsibility level D
Assessment criteria: Self-development managed typically: 11.1 Strategy independently adopted to enhance professional development evident. 11.2 Awareness of philosophy of employer regarding professional development evident.	11.1 If possible, a specific field of the sub-discipline is chosen, available developmental alternatives established, a programme drawn up (in consultation with employer if costs are involved), and options open to expand knowledge into additional fields investigated. 11.2 Record keeping must not be left to the employer or anybody else. The trainee must manage his/her own training independently, taking initiative and being in charge of experiential development towards Engineer, Technologist and Technician engineering.
Range Statement: Professional development involves: a) planning own professional development strategy b) selecting appropriate professional development activities c) recording professional development strategy and activities, while displaying independent learning ability.	a) In most places of work training is seldom organised by a training department. It is up to the Engineer, Technologist and Technician to manage his/her own experiential development. Engineer, Technologist and Technician frequently end up in a 'dead-end street' being left behind doing repetitive work. If self-development is not driven by him/herself, success is unlikely. b) Preference must be given to engineering development rather than developing soft skills. c) Developing a learning culture in the workplace environment of the Engineer, Technologist and Technician is vital to his/her success

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APPENDIX B: TRAINING ELEMENTS SCOPE

1	Introduction
1.1	<i>Induction programme (typically 1–5 days)</i>
1.1.1	Company structure
1.1.2	Company policies
1.1.3	Company Code of Conduct
1.1.4	Company safety regulations
1.1.5	Company staff code
1.1.6	Company regulations
1.2	<i>Exposure to Practical Aspects of Engineering (typically 6–12 months) and covers how things are: (Responsibility Levels A–B)</i>
Experience in one or more of these sectors but not all:	
1.2.1	Manufacturing
1.2.2	Construction
1.2.3	Erection
1.2.4	Field installation
1.2.5	Testing
1.2.6	Commissioning
1.2.7	Operation
1.2.8	Maintenance
1.2.9	Fault location
1.2.10	Problem investigation
2	Design or develop solution
2.1	<i>Experience in design and application of design knowledge (Typically 12–18 months) Focus is on planning, design and application (Responsibility Levels C–D)</i>
In one or more of the above sectors:	
2.1.1	Analysis of data and systems
2.1.2	Planning of networks and systems
2.1.3	System modelling and integration

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2.1.4	System design
2.1.5	Network/circuit design
2.1.6	Component/product design
2.1.7	Software design
2.1.8	Research and investigation
2.1.9	Preparation of specifications and associated documentation
2.1.10	Preparation of contract documents and associated documentation
2.1.11	Development of standards
2.1.12	Application of quality systems
2.1.13	Configuration Management
3	Engineering tasks
3.1	<i>Experience in the execution of engineering tasks (rest of training period). Focus should be on projects and project management (Responsibility Level E)</i>
Working in one or more of these sectors but not all:	
3.1.1.	Design or develop solution
3.1.2	Solution Acquisition or Development
3.1.3	Solution Manufacturing or Configuration
3.1.4	Solution Testing
3.1.5	Installation
3.1.6	Commissioning
3.1.7	Maintenance and Support
3.1.8	Modifications
3.2	<i>Organising for implementation of 3.1 (Responsibility Level E)</i>
3.2.1	Manage resources
3.2.2	Optimisation of resources and processes
3.3	<i>Controlling for implementation or operation of 3.1 (Responsibility Level E)</i>
3.3.1	Monitor progress and delivery
3.3.2	Monitor quality
3.4	<i>Completion of 3.1 (Responsibility Level E)</i>
3.4.1	Commissioning completion
3.4.2	Documentation completion
3.4.3	Documentation handover

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3.5	<i>Maintenance and repair of 3.1</i> (Responsibility Level E)
3.5.1	Planning and scheduling maintenance
3.5.2	Monitor quality
3.5.3	Oversee maintenance and repair
4	Risk and impact mitigation
4.1	<i>Impact and risk assessments</i> (Responsibility Level E)
4.1.1	Risk assessments
4.2	<i>Regulatory compliance</i> (Responsibility Level E)
4.2.1	Health and safety
4.2.2	Codes and standards
4.2.3	Legal and regulatory
5	Managing engineering activities
5.1	<i>Self-management</i> (Responsibility Levels C–D)
5.1.1	Manages own activities
5.1.2	Communicates effectively
5.2	<i>Team environment</i> (Responsibility Levels C–D)
5.2.1	Participates in and contributes to team planning activities
5.2.2	Manages people
5.3	<i>Professional communication and relationships (networking)</i> (Responsibility Levels C–D)
5.3.1	Establishes and maintains professional and business relationships
5.3.2	Communicates effectively
5.4	<i>Exercising judgement and taking responsibility</i> (Responsibility Level E)
5.4.1	Ethical practices
5.4.2	Code of Conduct
5.4.3	Exercises sound judgement in the course of complex engineering activities
5.4.4	Is responsible for decision-making in some or all engineering activities
5.5	<i>Competency development</i> (Responsibility Level D)
5.5.1	Plans own development programme
5.5.2	Constructs initial professional development record

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