Systems Engineering Area of Practice

Systems engineering deals with the interdisciplinary approach and means to enable the realisation of successful systems.

It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem:

- operations

- performance

- test

- manufacturing

- cost and schedule

- training and support

- disposal.

It integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation and considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

Some of the indicative activities that may be undertaken when practising systems engineering are:

- Application of architectural and design skills to decompose the system specification into a structured hierarchy of progressively smaller but cohesive sub-systems and well defined interfaces.

- Continuous change, release and configuration management of the system, its sub systems and interfaces.

- Defining and scoping customer or stakeholder needs and required functionality early in the development cycle.

- Development of an agreed system specification.

- Structured validation, verification and integration of the sub-systems while continuously considering the complete system problem.

These activities could take place in any of the following systems engineering domains:

- civil infrastructure (power stations, offshore, mining, energy networks)

- transport (road, rail, air, maritime)

- defence and aerospace

- emergency services

- information and communications technology (ICT)

- intelligent transport

- medical engineering

- national security

- telecommunications

- power (generation, transmission, distribution)

The Australian/International standard AS/NZS ISO/IEC 24773 Part 3 informs the Best Practices in Systems Engineering Certification. This standard requires a certification scheme to:

- Declare a reference Body of Knowledge (BoK) as the basis on which to test the cognitive understanding of an applicant for certification.

- Declare skills that demonstrate the application of this knowledge to professional practice.

- Identify generic competencies associated with professional practice and code of ethics.

The following are the requisite components that underpin systems engineering.

Body of knowledge

BoK: *International Council on Systems Engineering (INCOSE) System Engineering Handbook*.

Applicants must be able to demonstrate an appropriate level of understanding of the BoK.

Competency

The INCOSE Systems Engineering Competency Framework (ISECF) provides a comprehensive basis for Systems Engineering Technical Competencies. The Systems Engineering Area of Practice Competency Framework consists of the ISECF Core Competencies and the Technical Competencies, together with the Engineers Australia Experienced Professional Engineer Stage 2 Competencies.

Core competencies that underpin systems engineering

Core competencies underpin engineering as well as systems engineering.

- Systems thinking: the application of the fundamental concepts of systems thinking to systems engineering.

- Lifecycles: selection of the appropriate lifecycles in the realisation of a system

- Capability engineering: an appreciation of the role the system of interest plays in the system of which it is a part.

- General engineering: foundational concepts in mathematics, science and engineering and their application.

- Critical thinking: the objective analysis and evaluation of a topic in order to form a judgement.

- Systems modelling and analysis: provision of rigorous data and information including the use of modelling to support technical understanding and decision making.

Technical competencies that underpin systems engineering

The ability to perform tasks associated primarily with the suite of technical processes identified in the *INCOSE Systems Engineering Handbook*.

- Requirements definition: to analyse the stakeholder needs and expectations to establish the requirements for a system.

- System architecting: the definition of the system structure, interfaces and associated derived requirements to produce a solution that can be implemented.

- Design: ensuring that the requirements of all lifecycle stages are addressed at the correct point in the system design.

- Integration: the logical process for assembling a set of system elements and aggregates into the realised system, product or service.

- Interfaces: the identification, definition and control of interactions across system or system element boundaries

- Verification: a formal process of obtaining objective evidence that a system fulfils its specified requirements and characteristics.

- Validation: a formal process of obtaining objective evidence that the system achieves its intended use in its intended operational environment.

- Transition: integration of a verified system into its operational environment including the wider system of which it forms a part.

- Operation and support: when the system is used to deliver its capabilities and is sustained over its lifetime.

Skills

INCOSE and AS/NZS ISO/IEC 24773 Part 3 declares the following are the main skills or function areas for systems engineering:

- requirements engineering

- acquisition and supply

- system and decisions analysis

- information and configuration management

- architecture and design development

- risk and opportunity management

- systems integration

- lifecycle process definition and management

- verification and validation

- specialty engineering

- system operation and maintenance

- organisation project enabling activities

- technical planning

- technical monitoring and control.

Applicants must be able to provide evidence of systems engineering competency achievement with evidence of at least five years (total) of systems engineering experience with at least one year of systems engineering experience in at least three of the above 14 function areas.

A mapping between the knowledge, skills and competencies can be found in annexes of AS/NZS ISO/IEC 24773 Part 3.

Systems engineering is an area of practice and available to those wishing to become Chartered. It is available to all occupational categories.

Training and experience will be required to be demonstrated.

For more information on systems engineering, visit the Engineers Australia website.