Systems engineering
Consultation document

AUGUST 2025

REGISTRATION AUTHORITY
FOR CHARTERED PROFESSIONAL ENGINEERS

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Introduction

Purpose

Engineering New Zealand, as the Registration Authority for Chartered Professional Engineers, is considering a proposal to establish Systems Engineering as a distinct practice field within the CPEng framework.

The International Council on Systems Engineering (INCOSE) is the leading association for Systems Engineers worldwide and operates in at least 68 countries including Aotearoa New Zealand. Together, Engineering New Zealand and INCOSE have developed this proposal to formally recognise Systems Engineering within the CPEng framework.

We now seek stakeholder feedback to assess the need for this new field. This consultation provides an opportunity to consider the potential benefits, risks, and impacts before the CPEng Board makes a final decision.

This document outlines the proposed practice field, the rationale for its inclusion, and a summary of the competence framework – described in detail in the SEBoK (Systems Engineering Body of Knowledge) – that would be used in assessments.

Current practice fields

An engineering practice field is a broadly defined area of professional engineering activity that represents an area of practice within the engineering profession and aligns with international categorisation.

Currently, Engineering New Zealand recognises over 20 practice fields – definitions of these are available on our website. Engineers applying for registration as Chartered Professional Engineers (CPEng) select the practice field(s) that best aligns with their area of engineering practice. These are displayed on the CPEng Register to help the public find a registered engineer.

Feedback invited for new Systems Engineering field

We invite your feedback on whether you support the introduction of a new Systems Engineering practice field, and to provide feedback on any benefits, risks, and impacts that the CPEng Board should consider before a final decision is made. You can provide feedback by completing this feedback survey by **12 September 2025**.

Systems Engineering

Definition

Systems Engineering is a transdisciplinary and integrative approach to enable the successful realisation, use, and retirement of engineered systems, using systems principles and concepts, and scientific, technological, and management methods. (INCOSE 2023)

Systems Engineers consider the complete context of a problem and help multidisciplinary teams collaborate to better understand and manage systems and their complexity, along with their unique risk profiles. To do this, Systems Engineers perform activities such as:

- Defining and scoping customer or stakeholder needs and required functionality early in the development cycle.
- Establishing appropriate system lifecycle models, processes, and governance structures, that take the levels of complexity, uncertainty, and change into consideration.
- Applying architectural and design skills to generate and evaluate alternative solution concepts and architectures.

- Developing agreed system specifications.
- Planning and performing structured validation, verification and integration of the sub-systems while continuously considering the complete system problem, and context of the system including interfacing systems and stakeholders.

Rationale

Emerging industry need

It's well publicised that New Zealand has an infrastructure deficit. Our world is becoming more complex and interrelated, so we anticipate a growing number of large and complex engineering programs in Aotearoa that have a wide range of conflicting stakeholders and complex interfacing systems. Because of this, there is a growing interest in Systems Engineering, as it is an approach that manages this complexity and provides assurance that the overarching need is met.

Relevance to engineering

The Systems Engineer uses engineering knowledge and skills to engineer systems which achieve their intended purpose, within applicable constraints, considering the system's entire lifecycle. These systems impact the public and the environment, so the Systems Engineer is expected to ethically consider the wider intended and unintended impacts of their work.

The knowledge and skills of Systems Engineering is supported by numerous standards and literature, which the Systems Engineer appropriately tailors to mitigate technical project and delivery risk. These standards and literature originate from multiple organisations, including:

- **Relevant Standards:** ISO/IEC/IEEE 15288:2023 is a core Systems Engineering standard. A good list of standards used by Systems Engineers is found at **Relevant Standards - SEBoK**
- **Bodies of Knowledge** have been provided both by INCOSE and other organisations such as NASA and the US DoD that employ Systems Engineers:
  - **The INCOSE SE Handbook V5.0**
  - **SEBoK (Systems Engineering Body of Knowledge):** Is an online wiki-style body of Knowledge
  - **The NASA SE Handbook**
  - **The US DoD Systems Engineering Guidebook**
- **Academic journals and international conference proceedings** which publish new Systems Engineering approaches and findings, including:
  - **Systems Engineering Journal**
  - **IEEE Systems Journal**
  - **Proceedings of INCOSE International Symposium**

Systems Engineering is increasingly recognised as a critical discipline in the successful delivery of safe, reliable, and complex systems in sectors including transport, energy, defence, ICT, health, infrastructure, and emergency services.

Industry and professional demand

The International Council on Systems Engineering (INCOSE) has a membership of over 25,000 engineers worldwide and operates across at least 68 countries. The New Zealand Chapter, INCOSE NZ, has grown to 59 members since its formation in 2022, representing only a subset of those employed professionally as Systems Engineers within the New Zealand workforce.

Recognising Systems Engineering as a distinct practice field acknowledges the critical role engineers play in designing, integrating, and managing complex systems that underpin modern infrastructure and services. This will provide practitioners with:

- **Professional recognition** for their expertise and contributions.
- **Clear career pathways** for engineers specialising in Systems Engineering.
- **Stronger collaboration** across engineering and technical disciplines to deliver integrated, high-performing systems in complex environments.

By formalising Systems Engineering within the CPEng framework, we not only strengthen the profession but also help ensure that New Zealand can design and deliver complex, integrated, and future-ready systems across infrastructure, defence, technology, and public services.

Distinctiveness and international alignment

The Systems Engineer's approach to managing complexity and sustaining a clear trace to the initial needs underpinning an engineering project are distinct from the existing CPEng Practice Fields.

The Systems Engineering community's approach to managing complexity is continuously adapting to meet the growing demand to manage more complex systems over tighter timelines. This has led to the introduction of agile systems engineering methods, model-based systems engineering, and the use of Digital Engineering approaches, (see **sebokwiki.org/wiki/emerging_topics**).

There is a need for specialist Systems Engineering literature and organisations, so that Systems Engineers can share, develop, and standardise the outcomes achieved from applying their distinctive knowledge and skills.

Organisations, both within New Zealand and internationally, have specific Systems Engineering roles where there is a need to manage complexity, and/or sustain assurance that programs focus their efforts to develop outcomes that address the overarching needs. Systems Engineering is already recognised as a Practice Field in other countries, including Australia and the UK.

Public and stakeholder benefit

Systems Engineering aims to provide full traceability between the initial need, requirements, design, risks, and verification evidence. This provides program teams and their stakeholders with a common vision and understanding of the need, and how the program's outputs align with that need. In other words, Systems Engineering provides high assurance that program outcomes are going to meet the overarching need, that the outcomes are safe, and that scope and costs are well understood. New Zealand has done some great things with its "number 8 wire" attitude, but a more systematic approach is required to give us assurance that we can bridge our infrastructure deficit in a safe, cost-effective manner.

Readiness for implementation

If approved, the Registration Authority will ensure the new field is adequately resourced with suitable, trained practice area assessors capable of evaluating applications in the systems engineering field.

Areas a Systems Engineer might work in

Systems Engineers operate across a diverse range of engineering domains and industries, where their expertise ensures the successful design, integration, and management of complex systems throughout the system lifecycle. Systems Engineering is a cross-domain discipline. Examples of key domains include, but are not limited to:

- civil infrastructure (power stations, offshore, mining, energy networks)
- transport (road, rail, aerospace, maritime)
- defence and aerospace
- emergency services
- information and communications technology (ICT)
- intelligent transport

- medical engineering
- national security
- telecommunications
- power (generation, transmission, distribution)

Competency framework and CPEng performance indicators

The Australian/New Zealand standard AS/NZS ISO/IEC 24773-3 provides a robust framework for certifying Systems Engineering professionals. In line with this standard, the proposed Systems Engineering practice field under CPEng, should it be approved, will be underpinned by a recognised Body of Knowledge, practice-based performance indicators, and professional competencies – ensuring consistency with international best practice and supporting the mobility and credibility of New Zealand engineers.

Body of Knowledge

The Body of Knowledge for systems engineering is published in the International Council on Systems Engineering (INCOSE) System Engineering Handbook. Applicants must be able to demonstrate an appropriate level of understanding of the BoK.

CPEng performance indicators

The Systems Engineering BoK and competency framework has been framed within the CPEng competency groups below. During the assessment process, the indicators below would not be intended to serve as a strict checklist or tick-box exercise. Instead, assessment panels will take a holistic view of the evidence presented and exercise their professional judgement to determine whether, overall, an applicant meets the standard for registration in this field.

Engineering Knowledge
CPEng competence standard description • Comprehend, and apply their knowledge of accepted principles underpinning: i. widely applied good practice for professional engineering; and ii. good practice for professional engineering that's specific to New Zealand. • Maintain the currency of their professional engineering knowledge and skills.
Performance indicators for Engineering Knowledge in Systems Engineering All applicants must hold a Washington Accord degree or demonstrated equivalence[1]. 1. **Systems thinking:** the application of the fundamental concepts of systems thinking to systems engineering. 2. **Lifecycles:** selection of the appropriate lifecycles in the realisation of a system 3. **Capability engineering:** an appreciation of the role the system of interest plays in the system of which it is a part. 4. **Foundational engineering knowledge:** Leverage mathematics, science, and engineering fundamentals across system contexts 5. **Continuous learning and innovation**: Engage in lifelong learning, embrace new methods and technologies 6. **Critical thinking**: objective analysis and evaluation of a topic in order to form a judgement. 7. **Systems modelling and analysis:** provision of rigorous data and information including the use of modelling to support technical understanding and decision making.

[1] Equivalence can be demonstrated through the Knowledge Assessment process. Full knowledge assessment guidance is available on our guidance page.

Managing Engineering Work

CPEng Competence Standard criteria

- Exercise sound professional engineering judgement.
- Be responsible for making decisions on part or all of one or more complex engineering activities.
- Manage part or all of one or more complex engineering activities in accordance with good engineering management practice.
- Identify, assess, and manage engineering risk.

Performance Indicators for Managing Engineering Work in Systems Engineering

1. **Planning:** Develops structured plans to guide system activities, aligning with stakeholder needs, resources, and timelines. Anticipates dependencies and adapts plans as systems evolve.
2. **Monitoring and control:** Tracks system performance, progress, and compliance against plans and standards. Identifies variances and implements corrective actions to ensure outcomes remain on track.
3. **Decision management:** Applies clear, traceable, and justifiable decision-making processes throughout the system life cycle. Balances technical, commercial, and stakeholder considerations to make informed choices.
4. **Concurrent engineering:** Promotes cross-disciplinary collaboration to integrate system elements early and iteratively. Reduces rework and enhances design efficiency through parallel development efforts.
5. **Business and enterprise integration:** aligns system development with business strategy, policies, and enterprise architecture. Considers organisational impacts and ensures the system supports broader business objectives.
6. **Acquisition and supply:** Manages procurement and supplier relationships to ensure fit-for-purpose components and services. Defines clear requirements and oversees delivery to achieve system goals.
7. **Information management:** Ensures the accurate capture, organisation, and flow of information throughout the system life cycle. Supports traceability, reuse, and compliance through structured data practices.
8. **Configuration management:** Maintains the integrity and traceability of system elements and documentation. Controls changes systematically to prevent unintended consequences and preserve system coherence.
9. **Risk and opportunity management:** Identifies, analyses, and manages uncertainties to protect and enhance system performance. Proactively addresses threats and leverages opportunities throughout the life cycle.

Professional Acumen

CPEng Competence Standard Description

- Conduct their professional engineering activities to an ethical standard at least equivalent to the Code of Ethical Conduct.
- Recognise the reasonably foreseeable social, cultural, and environmental effects of professional engineering activities generally.
- Communicate clearly to other engineers and others they are likely to deal with in the course of their professional engineering activities.

Performance Indicators for Professional Acumen in Systems Engineering

1. **Communication**: Present systems concepts effectively to technical and non-technical audiences.
2. **Professional ethics**: Uphold ethical standards and conduct in line with the CPEng Codes of Ethical Conduct and expected professional behaviours
3. **Information and configuration management**: Manage documentation, models, and data integrity.
4. **Leadership and teamwork**: Lead and collaborate across disciplines, mentor peers, and function in diverse teams

5. **Negotiation and facilitation**: Follows established best practice strategies for negotiation in terms of preparation, approach, strategy, tactics and style. Facilitate problem solving sessions, helping others to deal with a process, solve a problem, or reach a goal without getting directly involved.
6. **Emotional intelligence, coaching & mentoring**: Demonstrates self-awareness, empathy, and the ability to navigate complex interpersonal dynamics. Supports the development of others through effective coaching, mentoring, and knowledge sharing to build team capability and resilience.
7. Where relevant, considers and integrates **Te Ao Māori principles and other cultural factor**s into engineering decision-making processes, applying culturally informed technical solutions to systems engineering practise

Developing Technical Solutions

CPEng Competence Standard Description

- Define, investigate, and analyse complex engineering problems in accordance with good practice for professional engineering.
- Design or develop solutions to complex engineering problems in accordance with good practice for professional engineering.

Performance Indicators for Developing Technical Solutions in Systems Engineering

1. **Requirements definit**ion: Elicit and analyse stakeholder needs to develop clear system requirements
2. **System archite**cting: the definition of the system structure, interfaces and associated derived requirements to produce a solution that can be implemented.
3. **Design:** ensuring that the requirements of all lifecycle stages are addressed at the correct point in the system design.
4. **Integration:** the logical process for assembling a set of system elements and aggregates into the realised system, product or service.
5. **Interfaces:** the identification, definition and control of interactions across system or system element boundaries
6. **Verification:** a formal process of obtaining objective evidence that a system fulfils its specified requirements and characteristics.
7. **Validation:** a formal process of obtaining objective evidence that the system achieves its intended use in its intended operational environment.
8. **Transition:** integration of a verified system into its operational environment including the wider system of which it forms a part.
9. **Operation and support:** when the system is used to deliver its capabilities and is sustained over its lifetime.
10. **Retirement:** Plans for and manages the responsible transition or conclusion of engineering work, ensuring continuity and knowledge transfer. Recognises when a system, component, or role has reached end-of-life and acts ethically to retire it with minimal disruption or risk.

Impact on CPEng registrants

If you're already registered as a CPEng and would like to register in Systems Engineering (should the decision be made to establish this new practice field option), you have the option to wait until your next reassessment to add this, or apply via a mutual recognition assessment application and complete a form which will require you to provide self-assessment and evidence statements for competency group 1 (Engineering Knowledge) and competency group 4 (Developing Technical Solutions).

We would work closely with INCOSE to develop clear transition arrangements for currently accredited INCOSE CSEP engineers. For example, CSEP accreditation may be accepted as evidence of meeting the competencies in Engineering Knowledge, Managing Engineering Work, and Developing Technical Solutions. This could enable a shorter assessment pathway for CSEP-accredited professionals who also meet the standard CPEng eligibility requirements (being a Washington Accord-accredited degree or demonstrated equivalence).

Do you support the Registration Authority introducing a new practice field for Systems Engineering? Why/Why not?

If a new field for Systems Engineering was made available, would you apply for CPEng registration in this field?

Are there any potential impacts, on business, engineers, or the public, that we need to consider before establishing a new Systems Engineering field?

Are there any risks we need to consider before establishing a new Systems Engineering field?

Conclusion and next steps

In this document we have proposed to introduce a new CPEng practice field for Systems Engineering, which would allow engineers applying for CPEng for the first time, or applying for continued CPEng registration, to apply for CPEng registration in a Systems Engineering field.

Thank you for taking the time to review this proposal. We welcome your feedback by **12 September 2025**. You can complete our online survey or email your feedback to registrar@engineeringnz.org

After we receive feedback on this consultation document, we will consolidate feedback for the CPEng Board's review and decision in late-2025. If approved, we will announce the new field, publish the new field description on the Registration Authority's website, assess and register the first engineers in the new field and train them as the practice area assessors who will assess applications in the new field, and make the new field available to applicants.