Systems Engineering Masters Level Standard

OCCUPATION AND OCCUPATIONAL PROFILE

Systems Engineers focus on solving some of the most complex engineering challenges. They do this by collecting and organising all the information needed to understand the whole problem, exploring it from all angles, and then finding the most appropriate solution. This apprenticeship aims to create rounded professional Systems Engineers who understand and can practise Systems Engineering. Primarily focussed on the Defence sector, the apprentice will be able to undertake INCOSE[1] Practitioner level Systems Engineering roles across Defence projects but also in other sectors, since many of the core skills will be transferable.

A Systems Engineer might typically work in either the problem definition or solution provider environments, mapping out the requirements for a complex system and defining architectures for different potential solutions, reflecting all influences across the system lifecycle; and then testing and accepting the designed solutions.

ENTRY REQUIREMENTS

Employers will set their own entry requirements which are likely to be at Framework for Higher Education Qualifications (FHEQ) Level 6 - equating to a Higher Apprenticeship, an existing engineering degree or an equivalent amount of experience (to meet Quality Assurance Agency (QAA) requirements). The scheme is designed both to upskill existing engineers and attract new entrants in early or mid-career.

KNOWLEDGE, SKILLS AND BEHAVIOURS

Success will be achieved through the combination of part-time Masters level learning in Systems Engineering and additional structured work placements doing real work to apply, practice and develop the skills and knowledge learned.

This apprenticeship will foster a common approach and language through core elements, and also allow for tailored specialist learning matched to Employers' individual needs. An individual competency profile will be created to match each Apprentice's circumstances and needs, based on the INCOSE competencies[2].

KNOWLEDGE AND SKILLS

Systems Thinking[3]	Methods and techniques to identify problems and needs, capture and manage requirements, design solutions aided by architectures, support the build process and validate solutions. An understanding of the different types of real world complex systems, including what a system is, its context within its environment and its boundaries and interfaces. An appreciation that systems may have emergent behaviours that cannot be predicted from the behaviour of individual subsystems.
Holistic Lifecycle View[3]	Applying appropriate lifecycles and approaches to developing systems, including their interrelated dependencies and benefits. The skills, tasks and engineering products associated with each lifecycle phase, from identifying the problems and stakeholder needs, the system requirements through to the operation and ultimately disposal of the system.
Systems Engineering Management[3]	The ability to manage complex interdependencies between different functions of large enterprises, often involving concurrent lifecycle activities and parallel development at multiple levels of abstraction and incorporating diverse specialist disciplines. Awareness of Project & Programme Management, business, financial and commercial context and competencies.
Domain[4]	Understand the Defence sector, its structure, funding and functions. Understanding of how the military operates. How Systems Engineering is used and an awareness of key transversal skills, for example safety, reliability and human factors.
Specialisms	Knowledge of particular specialist subjects and domains to meet Employers' needs, for example in relation to emerging technologies, niche skills gaps (for example software or maritime systems) or in relation to business, financial or commercial skills.

BEHAVIOURS

Continuing Professional Development (CPD)	Undertake planning and review of own development needs and carry out CPD. Regularly reflect on own competence and behavioural development. Assist others with their own CPD.

[1] International Council on Systems Engineering, the international professional body for Systems Engineering
[2] INCOSE UK Systems Engineering Competencies Framework (2010)
[3] Reproduced with permission from the INCOSE UK Systems Engineering Competencies Framework (2010)
[4] Note this could be replaced by the needs of a different sector if there is take-up from beyond the Defence sector

Professional Participation	Comply with the codes of conduct of own professional institution. Actively engage in forums advancing Systems Engineering as a profession.
Effective Communication and Systems Engineering Thought-Leadership	Effective written and oral communication, influencing, negotiation, facilitation and conflict resolution in Systems Engineering contexts across multiple domains.
Integrative Systems Engineering Leadership Behaviours	Critically observe leadership behaviours of self/others and reflect on their effectiveness, noting the importance of influence as well as authority. Demonstrate the ability to adapt own behaviours to needs of different systems engineering situations and people.
Change[5]	Embrace, instigate and implement change in systems engineering contexts. Demonstrate a willingness to embrace and manage systems engineering risks, issues, opportunities, assumptions and dependencies.
Adaptation[5]	Demonstrate an awareness of changing situations including personal, organisational and political views. Testing, analysing, reflecting, rethinking and adapting your approach accordingly.
Problem-Finding[5]	Clarify stakeholder's needs, check and evaluate existing solutions, systems and processes. Investigate, identify and clarify influencing factors and be able to effectively communicate identified issues to various interested parties.
Creative Problem-Solving[5]	Approach problems from different perspectives, applying different techniques to generate ideas and solutions with others, critique ideas of your own and others, facilitate others in the development of their own ideas, decide and gain agreement on a course of action, plan and conduct this action and analyse and review the action and outcome.
Visualising[5]	Look at problems from different perspectives, able to create then move from abstract ideas and concepts to real world systems and processes, ability to communicate visually concepts and ideas and be able to assess the feasibility of practical design solutions.
Improving[5]	Strive to make designs, solutions and processes better by experimenting, designing, sketching, guessing, conjecturing, thought-experimenting and prototyping by obtaining user feedback, focusing and down-selecting improvement ideas and working with design teams to improve design functionality.

DURATION

The typical duration will be between three and a maximum of five years, depending on the amount of academic study and relevant vocational experience achieved each year, and the needs of each Apprentice. This would be expected to comprise completion of academic modules sufficient to achieve Masters level learning in Systems Engineering, and work assignments designed by the Employer in conjunction with academic providers. Academic content could be from a range of providers and some work assignments could occur with other Employers to provide a richer learning experience.

QUALIFICATIONS

As a Masters level learning programme, Apprentices might typically acquire an MSc, Post Graduate Diploma or Post Graduate Certificate in Systems Engineering, although alternative learning routes can be pursued.

LINK TO PROFESSIONAL REGISTRATION

An Apprentice will achieve the standard of INCOSE Systems Engineering practitioner. In addition, this apprenticeship will align with the professional registration requirements for Chartered Engineer[6].

LEVEL

This is a Level 7 apprenticeship.

REVIEW

This Standard will be reviewed within 3 years.

[5] Reproduced with permission from the Royal Academy of Engineering's 'Engineering Habits of Mind' in 'Thinking Like an Engineer' May 2014

[6] UK-SPEC, the UK Standard for Professional Engineering Competence Third Edition