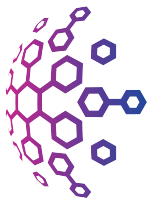
Institute for
Systems Engineering

IfSE SEASON Report 2026

Systems Engineering Assessed State of the Nation



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Systems Engineering

The Institute for Systems Engineering

SEASON Report 2026

Systems Engineering Assessed State of the Nation

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Brooke Lewis, Chair IfSE D&I Committee

Professor Jon Holt, former Technical Director

Contents

Executive Summary

This SEASON Report serves to benchmark the professional capabilities, challenges and opportunities for the Institute for Systems Engineering (IfSE), the Professional Engineering Institute serving Systems Engineering and systems engineers within the UK. IfSE achieves this by:

- Working with other organisations concerned with, and promoting, engineering professionalism within the United Kingdom, including the Engineering Council, EngineeringUK, the Royal Academy of Engineering, and other Professional Engineering Institutes
- Benchmarking UK capabilities in Systems Engineering, including those within academe
- Articulating where concentrations of Systems Engineering capability exist, both within industrial sectors and also in specific geographical regions within the UK
- Understanding how careers in Systems Engineering are forged and the contributions made by universities, training providers and through learning by doing 'on the job'
- Recognising and certifying levels of practitioner capability in Systems Engineering
- Examining the relationship between Systems Engineering as practised in the UK with that practised globally, especially that espoused by the international not-for-profit organisation INCOSE
- Identifying the growing need for systems engineers in the UK, the sorts of skills and capabilities they will need, and how engineers are going to be attracted, developed and retained within the profession

This Report summarises the scope, applicability, importance, and benefits of Systems Engineering and the required characteristics of systems engineers. It articulates a vision for Systems Engineering in the UK including the sorts of developments in the discipline which will need to be embraced or even pioneered.

As a professional discipline, Systems Engineering is challenged by factors such as its relative immaturity and limited, but growing, application. Its appropriate application is a key enabler for many of the complex engineering endeavours which the UK wishes and needs to undertake. The UK aspires to regenerate its industrial base and to lead many such complex engineering endeavours and for this proficient Systems Engineering will be required.

IfSE intends to rise to meet such challenges and opportunities through (1) growing the numbers of people attracted into this branch of engineering and (2) by helping to equip them with the capabilities they need to deliver and enhancing Systems Engineering as a professional discipline. This will require an inclusive approach which draws upon diverse areas of capability to develop greater numbers of practitioners who are equipped with the necessary skills to be proficient. IfSE serves as the focal point in the UK for orchestrating and coordinating this endeavour, having established relationships with government, industry and academe, and through the range of professional development and engagement activities it undertakes.

Introduction

Background to the SEASON Report

The SEASON Report is a national baseline of the UK's Systems Engineering capability. The original report was issued in 2009, restructured and updated in 2014 update, and then further revised in 2020. The 2020 update was carried out by the Council of the UK Chapter of INCOSE, the International Council on Systems Engineering.

This SEASON Report has been devised by the Institute for Systems Engineering, IfSE, which succeeds INCOSE UK as the Professional Engineering Institute (PEI) for Systems Engineering within the UK. IfSE remains affiliated with the international professional body for Systems Engineering, INCOSE, continuing to serve as its UK Chapter.

Systems Engineering helps provide an understanding of the complexity of our modern world and its growing inter-connectedness, including through the expanding use of modern technology. It is increasingly recognised as a discipline underpinning many areas of problem understanding in addition to engineering-based solution development. Systems Engineering enables such complex problems to be solved drawing upon relevant scientific and technical disciplines to derive balanced, coherent and sustainable solutions. Allied techniques can also be used to better understand natural world processes.

The SEASON Report provides an evidence base on the state of Systems Engineering within the UK that can be used to inform decision makers in Government, Industry and Academia concerning the UK's national Systems Engineering capability. Refreshing it regularly ensures that the presented information is current, thereby supporting its continued usage in support of decision-making.

UK national capability in Systems Engineering contributes directly to the ability to acquire and develop complex systems for the UK (and overseas markets), to manage them through life, and to participate effectively in collaborative, international Systems Engineering endeavours. It maintains and grows the UK's economic and social viability and contributes to its international competitiveness as a value-added system and service integrator in the global supply chain. The 'real economy' needs systems skills as never before to develop viable systems and services which create real, enduring and environmentally sustainable value for the economy.

This SEASON Report was prepared through an inclusive process engaging corporate and individual members of IfSE, including national and international experts in Systems Engineering. It also draws on a wide range of sources both public and unpublished, such as INCOSE's Systems Engineering Vision 2035 [1].

What is IfSE?

The Institute for Systems Engineering (IfSE) is a Professional Engineering Institute licensed in the UK by the Engineering Council. IfSE is able to assess candidates for inclusion on the national register of professional engineers and technicians as Chartered Engineer (CEng), Incorporated Engineer (IEng) or Engineering Technician (EngTech).

Prior to July 2025 IfSE was known as INCOSE UK and was formed in September 1994 as the first international Chapter of INCOSE.

IfSE offers a range of resources to its members including:

- Participation in Working Groups; Interest Groups and Local Groups
- Access to training through its Endorsed Training Provider scheme
- Access to a range of publications, including the 'Don't Panic' range, beginner's guides to the different aspects of Systems Engineering, as well as the Advanced Applications books, Academic Journals, Educational and STEM books

IfSE runs the UK's foremost Systems Engineering conference, the Annual Systems Engineering Conference (ASEC), each November, which attracts systems engineers from a growing range of sectors.

The IfSE UK Advisory Board (UKAB) provides a forum for UK Systems Engineering organisations (within industry, government and academia) to influence the activities that IfSE undertakes, and the Systems Engineering best practice that IfSE promotes.

IfSE relies heavily upon volunteer effort, drawn from different parts of the country, different sectors, and with differing levels of knowledge and experience. This diversity enables the organisation to serve the many areas of application and also to support systems engineers at all stages in their careers.

What is INCOSE?

The International Council on Systems Engineering (INCOSE) is a not-for-profit membership organisation founded to develop and disseminate the transdisciplinary principles and practices that enable the realisation of successful systems. INCOSE is designed to connect Systems Engineering professionals with educational, networking, and career-advancement opportunities in the interest of developing the global community of systems engineers and systems approaches to problems. INCOSE is also focused on producing state-of-the-art work products that support and enhance this discipline's visibility in the world.

INCOSE was founded in 1990 as the National Council on Systems Engineering within the United States of America. It became INCOSE with inauguration of the UK Chapter in 1994. It has since grown to include 72 Chapters across 30 countries (Correct as of November 2025), made up of:

- Americas:
    - 43 US Chapters
    - Brazil, Canada and Latin America
- EMEA (Europe, Middle East and Africa)
    - 18 Chapters
- Asia – Oceania
    - 8 Chapters

INCOSE produces or contributes to some key guidance on Systems Engineering which is used globally. Such products include the ISO/IEC/IEEE 152888 system lifecycle process standard which is foundational to Systems Engineering and the INCOSE Systems Engineering Handbook. INCOSE produces numerous other publications including a Vision Report, Systems Engineering journal and various practitioner primers. It also organises and delivers an annual International Symposium and International Workshop in addition to Sector and Chapter meetings.

Report Overview

This SEASON Report contains the following information:

- An Executive Summary, written by the President and Outreach Director of the Institute for Systems Engineering (IfSE)
- An overview of Systems Engineering including demand for the discipline in the UK and UK views on future vision for the discipline
- Consideration of the state of Systems Engineering professionalism in the UK
- The state of Systems Engineering in Academia
- A discussion of Systems Engineering and the wider picture

Each of the main sections of the Report concludes with a short assessment of that topic.

Finally, the SEASON Report also provides a number of annexes that cover standards and other professional guidance, Systems Engineering employers in the UK, composition of the IfSE UK Advisory Board.

Overview of Systems Engineering

What is a System or may be considered as a System?

A System may be defined as 'a group of elements interacting with each other and their environment for a purpose'. Any System may be thought of as consisting of a set of interacting elements. Such elements may include people, processes, information, organisations and services as well as software, hardware and other complex elements.

A System also exhibits qualities such as properties or behaviours that are not exhibited by any of its elements alone. Such qualities may be intentional or non-intentional and, at the same time, desirable or non-desirable.

The elements that make up a System may be Systems themselves. These Systems are known as Constituent Systems and collaborate to form a System of Systems.

The exact definition of a System will vary depending how the System is viewed:

- The point of view, known as a context, and
- The level of abstraction, such as System level, Subsystem level, System of Systems level, etc.

Systems comprise of natural systems, enterprises, engineered systems, societal, conceptual and combinations of these. From a Systems Engineering perspective we are primarily concerned with engineered systems and secondarily with enterprise systems.

Indeed, it is generally accepted that one person's System is another person's Subsystem, which is another person's Constituent System!

What is Systems Engineering?

According to the international standard (ISO/IEC/IEEE 15288:2023 [2]) that serves as the fundamental for international practice in Systems Engineering, 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*

The need for Systems Engineering as a practised discipline is increasing as society requires greater utility, resource efficiency, value, performance and connectedness from technical devices. Such systems are becoming more complex due to their increasing functionality and connectedness, interaction with the physical environment, and integration of people with software and other technologies. Understanding what is needed from such systems and how they should be engineered, sustained and ultimately disposed of is the realm of Systems Engineering. It is easy to devise a solution that does not fully meet the needs or to solve the wrong problem which is why Systems Engineering has become such an important technical approach. The spanning of human functionality and characteristics with a range of technologies, often

including software, and realising desired solution characteristics, such as performance and safety, is why a transdisciplinary and integrative discipline is necessary.

The origins of Systems Engineering can be traced back to before World War II in both the UK and US. However, it was only really formalised and recognised as a discipline during the 1950s when it was applied in the US space and ICBM programmes, being described in a seminal text by Hall in 1962 [3]. The practice has grown in published guidance and areas of application covering not only the traditional aerospace and defence sectors but also transportation, healthcare, energy generation and distribution, national infrastructure, IT, security etc. Defined practice extends to standards such as ISO/IEC/IEEE 15288:2023, guidance such as the INCOSE Systems Engineering Handbook (currently at version 5, 2023) [4], and numerous textbooks and other professional guidance material. The INCOSE Systems Engineering Handbook serves internationally as the recognised professional Body of Knowledge for Systems Engineering – see ISO/IEC/IEEE 24773-3:2021 [5]. These are supplemented and elaborated further in professional publications including those published internationally by INCOSE together with those published in the UK by IfSE.

Systems Engineering is now recognised as a key enabler for success in our increasingly complex and rapidly changing world. It applies principles and practices of 'Systems Thinking' to identify and describe the problem that should be addressed together with potential interventions. These principles and practices are also employed in areas as diverse as social science and environmental management. Systems Thinking complements scientific thinking by addressing holism, emergence and intentionality.

As the maturity of Systems Engineering has increased, so too has the desirability of advanced approaches to handle the attendant complexity and scale of many systems. Such approaches have formalised the use of modelling and simulation techniques coupled with the power of computer-based tools in the form of Model-Based Systems Engineering (MBSE). The power of MBSE can ease many Systems Engineering considerations and is starting to help realise fully digital approaches to the engineering of systems.

Whilst a range of practices and perspectives of Systems Engineering has emerged during its history and across its areas of application, both IfSE and, internationally, INCOSE, aim to understand and, wherever possible, converge such practices and establish the underlying principles.

Benefits of Systems Engineering

There are many recognised benefits in applying Systems Engineering on projects for products and services, including at the System of System and enterprise levels. These include:

- Improved understanding of the needs of system stakeholders and, hence, the operational purpose, context including environment, value, and use of a system
- Reduced risk, as stakeholders' expectations are managed more effectively and risk-related issues addressed more systematically

- Increased probability of corresponding project success - less than 38% of projects 'succeed' (Standish CHAOS Report 2015 [6])
- Increased coherence between the system being devised and the enterprise devising it
- Increased discipline in the development of a solution encompassing definition of the problem to be solved and the corresponding solution including how engineering practices such as concerning architecting and design will be applied
- The identification and management of a system's emergent properties
- Managed complexity, allowing a better understanding of engineering considerations and their communication amongst stakeholders
- Greater understanding of the whole life of the system by considering its lifecycle together with temporal and scheduling issues
- Better change management through disciplined identification, management and control of changes throughout a system's development

Of course, the realisation of these benefits depends on the effective selection and application of suitable Systems Engineering techniques. This requires competent and effective people, processes and tools together with an appropriate organisation, infrastructure and management of information, and their timely application at an appropriate scale.

It should be noted that there is an optimum level of Systems Engineering that should be applied to typical projects. Too little or too much will result in either under-achievement or over-burdening on a project.

Systems Engineering and Other Disciplines

Systems Engineering is a transdisciplinary discipline. It therefore cuts across and in some respects sits above other engineering, managerial and scientific disciplines. It does this since it focuses on the problem to be solved and its corresponding solution, or at least strategies for intervening to improve the situation being contended with. It is also holistic, through-life and integrative in nature. This sets Systems Engineering apart from most other technical and managerial disciplines which tend to be targeted at more limited sets of considerations, such as particular properties or technologies, or are abstracted away from technical matters, in the case of managerial disciplines such as project management.

Systems Engineering is integrative in that it enables specific disciplines, such as which address technologies like software or properties like safety, to be orchestrated, harnessed, consolidated and cohered into the overall systems endeavour. It therefore has a relationship with many other disciplines and IfSE will therefore need to forge relationships and the mutual understanding with their respective professional bodies, including, in some cases, other PEIs.

These will include, noting that this list is by no means exhaustive:

Managerial disciplines

- Project Management (Association for Project Management (APM))

Engineering disciplines

Technology-focused disciplines

- IT and Software Engineering (British Computer Society (BCS)
- Civil Engineering (Institution of Civil Engineers (ICE))
- Electrical Engineering (Institution of Engineering and Technology (IET))
- Mechanical Engineering (Institution of Mechanical Engineers (IMechE)

Property-focused disciplines

- Safety Engineering (Safety and Reliability Society (SaRS), Safety-Critical Systems Club (SCSC))
- Security Engineering (Register of Security Engineers and Specialists (RSES))
- Reliability Engineering (Safety and Reliability Society (SaRS))

Scientific disciplines

- Physics (Institute of Physics (IOP))
- Systems Science (International Society for the Systems Sciences (ISSS))
- Operations Research (Operational Research Society (ORS))

Here it should be noted that the technology and property focused disciplines are sometimes referred to as 'Speciality ('specialty' in US parlance) Disciplines' but such reference appears to be diminishing internationally.

There are further engineering disciplines which are domain-focused in nature and which apply Systems Engineering, possibly in targeted practices focused on domain considerations. These include:

- Aerospace (Royal Aeronautical Society (RAeS))
- Energy (Energy Institute (EI))
- Rail Transportation (Permanent Way Institution (PWI), Institution of Railway Signal Engineers (IRSE))
- Ships and Marine Systems (Royal Institution of Naval Architects (RINA) Institute of Marine Engineering, Science and Technology (IMarEST)

Over time some of these professional bodies merge and others will form. In the case of the latter generally recognising the particular ranges of knowledge and skills or new specialisms that are required to address a particular class of problems. Further specialisms of Systems Engineering may also form as newer technologies such as quantum devices and artificial intelligence are increasingly integrated into systems.

Systems, Projects and Lifecycles

There are several key considerations that must be understood, managed and controlled when applying Systems Engineering. Figure 1 below shows some of the key concepts that must be considered for effective Systems Engineering and that are described in more detail in the following sections.

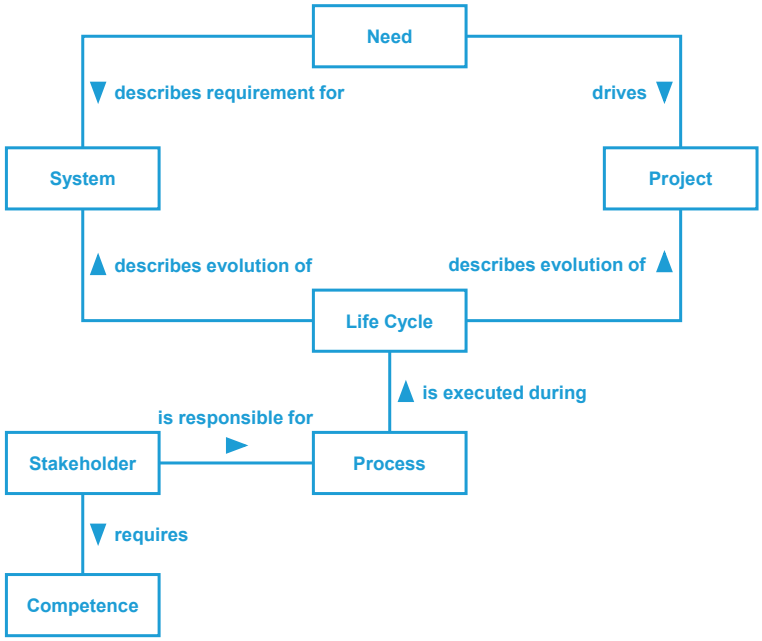

Figure 1: Key Systems Engineering Concepts

Fundamentally, it is important to understand that a Project will deliver a System (or a change to an existing system). The term 'Project' may relate to a programme of multiple Projects or a portfolio of programmes. The term 'System' refers to either a technical-type System or other types of Systems, including, but not limited to:

- Social Systems
- Financial Systems
- Environmental Systems
- Human Systems
- Process Systems

It is typical for several types of these systems to interact with one another causing additional complexity. In some cases, groups of interacting Systems may have their own purpose, unique properties and behaviours that combine into Systems of Systems.

Within Systems Engineering, it is important to understand the concept of a Life Cycle. A Life Cycle describes the evolution of something from its initial idea right up until its final disposal. This evolution is described by a number of 'Stages', typically: Concept, Development, Production, Utilisation and Support (typically executed in parallel) and Retirement.

Figure 2 shows an illustration of a simplified typical Life Cycle that is made up of five Stages and is based on the international standard ISO/IEC/IEEE 15288. A Life Cycle may be applied to a System, Project, Acquisition, Programme, Technology or any number of other contexts. These Life Cycles often interact to form more complex Life Cycles.

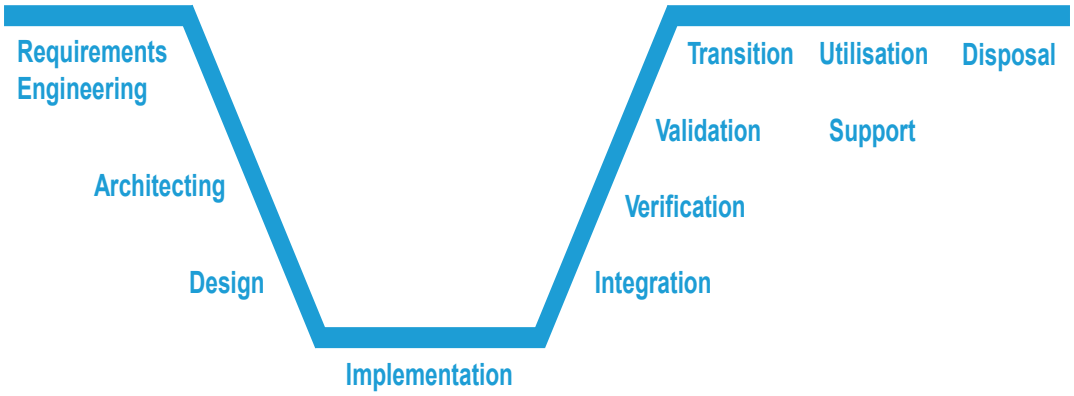

Figure 2: Generic Life Cycle, Stages and Processes

In order to transit from one Stage to the next, a Gate must be passed, typically assessed using a review.

Stages within the Life Cycle are typically executed in an iterative rather than linear fashion.

Within each Stage of a Life Cycle, a number of Processes are performed. A Process describes an established approach to carrying out specific operations. Processes will typically be described by a set of things to do, known as 'Activities' and 'Tasks', which will result in certain 'Outcomes'.

Processes cover areas such as: Technical, Management, Organisational and Agreement. Typical Technical Processes include: Stakeholder Needs & Requirements Definition, System Requirements Definition, Architectural Definition, Design Definition, System Analysis, Implementation, Integration, Verification, Validation, Transition, Maintenance, Operations and Disposal.

Like the Stages themselves, these Processes are typically executed in an iterative, rather than linear fashion within each Stage.

The set of Processes is used to demonstrate the Capability, or the ability of an organisation or organisational unit, to achieve its goals.

Stakeholders and Competence

A Stakeholder describes the role of any person, organisation or thing that has an interest in the System under development. It is essential that we think of the underlying role that the Stakeholder represents, and not the name of the person, organisation or thing that plays that role. For example, a single person may take on the role of many Stakeholders, so a single person may be playing the role of: designer, author, reviewer, etc. Likewise, a single Stakeholder role may be played by many people, such as the role of designer being played by many members of a team.

These Stakeholders are typically split into three broad categories:

- Customer Stakeholders (such as end users, operators and sponsors)
- External Stakeholders (such as standards, laws and the environment)
- Supplier Stakeholders (such as managers and engineers)

It is essential that each Stakeholder has the relevant skills, experience and attitude to carry out their activities. Therefore, each Stakeholder has a required 'Competence' that may be defined, measured and assessed to assure that the Processes may be executed effectively and efficiently.

In the same way that Capability helps us to demonstrate the ability of an Organisation, Competence helps us to demonstrate the ability of a Stakeholder.

We break down a Competence into a set of individual Competencies that may then be assessed and measured.

As is illustrated in Figure 3, the INCOSE Systems Engineering Competency Framework [7] identifies five areas of competencies that may be used to define competence for Systems Engineers:

Core Competencies - underpin engineering as well as Systems Engineering

Professional Competencies - behavioural competencies used by many professions

Management Competencies - related to the ability to perform the management tasks of Systems Engineering activities

Technical Competencies - related to the ability to perform the technical tasks of Systems Engineering activities

Integrating Competencies - related to the ability to integrate and join up development activities across other disciplines to achieve coherence

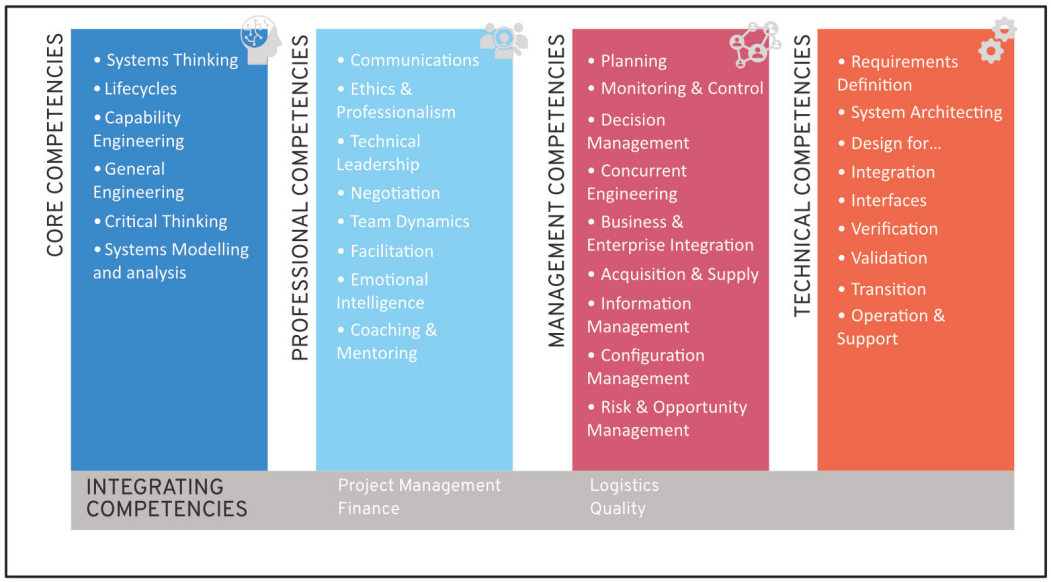

Figure 3: Systems Engineering Competency Framework

INCOSE defines five levels of Competence: 'awareness', 'supervised practitioner', 'practitioner', 'lead practitioner' and 'expert'. This has added the Lead Practitioner level since earlier work by INCOSE UK (now IfSE) to establish the framework.

Implementing Systems Engineering

The complexity of our Systems have evolved over time. As a direct result of this evolution, System complexity has increased by orders of magnitude over the last several decades. In order to cope with this ever-increasing complexity, our Systems Engineering approach has also evolved to reflect this. For example, we may consider Model-Based Systems Engineering being a necessary natural evolution of traditional document-based Systems Engineering, in order to cope with the increased demands of ever-more complex Systems.

Regardless of the Systems Engineering approach that we adopt, there are three key enablers that we must consider, which are: People, Processes and Tools.

Figure 4: Aspects of Systems Engineering Approach

We may consider each of these in more detail, as follows:

People: This means competent People with the appropriate skills, experience and attitude to perform the Systems Engineering. The INCOSE Systems Engineering Competency Framework is an example of best-practice Competence for Systems Engineering. The People will enable the Process.

Process: This means having an effective and efficient approach in place. This approach will include the definition and use of ontologies, frameworks, processes, guidelines and standards. Examples of well-established processes include those in ISO/IEC/IEEE 15288 and the INCOSE Systems Engineering Handbook.

The Process will drive the need for Tools and is enabled by the People.

Tools: This means anything that will help us to implement the process. Tools vary enormously in terms of their scale, application and sophistication: from pen-and-paper to computer-aided Tools; from text-based, to notational-based, to mathematical Tools; and from localised, individual Tools to company-wide Product Lifecycle Management (PLM) Tools. Very importantly, the selection and use of Tools should be driven by the Process and not the other way around, although enterprise factors are of course relevant.

Demand for Systems Engineering in the UK

The formalisation of the discipline of Systems Engineering in the UK really crystallised with the formation of INCOSE UK, the predecessor organisation to IfSE, in 1994. The organisation has grown largely continuously throughout the intervening time reflecting both increasing recognition of Systems Engineering as a distinct professional discipline in its own right and also the growing demand for Systems Engineering professionals (and their competences) in UK industry.

During this period some traditional sectors such as defence and aerospace have perhaps at best experienced a steady demand, whilst others such as transportation and healthcare have witnessed substantial growth. This has resulted in increasing demand for the Systems Engineering skill set across UK industry.

This situation of growth is expected to continue as issues such as engineering our physical environment to counter the effects of climate change are contemplated, smart cities are conceived, ageing infrastructure such as power generation and distribution capabilities are replaced, transportation becomes more service-focused and 'greener', healthcare becomes more holistic, preventative and personalised, and a resurgence in sovereign defence capability is required. This increasing need for Systems Engineering is recognised more widely than IfSE, such as by the Royal Academy of Engineering (RAEng). The RAEng is advocating the application of systems approaches in Government (e.g. healthcare, wastewater management, sustainable living places, policy prioritisation etc.) [8] and in particular areas such as safer complex infrastructure systems [9]. Industries including transportation [10] and (civil and defence) nuclear [11] are either making increased usage of systems skills or are expanding substantially, and this includes Systems Engineers.

The need to grow numbers of systems engineers in the UK is part of a broader need to increase numbers of engineers and technicians in the UK, recognising the increasing role which technology plays in all our lives and the desirability of increasing value-add from within the UK. Growing Systems Engineering in the UK cannot be achieved by just retraining engineers from other disciplines but must in large part be achieved organically.

Within IfSE the focus of recognising and understanding the growing demand for systems engineers has been the Advisory Board, which is composed of government, employers and academia. Notwithstanding pauses in major expenditure whilst a new Government conducts policy, spending and strategic reviews, and consequential shifts in funding priority, the perceived need for systems engineers in UK industry and Government is growing. Whilst many principles, skills and knowledge required of systems engineers are invariant with time, there will be increasing need for systems engineers to be digital natives, to be able to apply their expertise to new ranges of problems, and to be able to do so at pace.

National Centres of Excellence in, and drawing upon, Systems Engineering

There is increasing recognition of clusters of advanced industry in parts of the UK. Often these draw upon local universities for both providing pipelines of suitably qualified staff and also for undertaking research. Systems Engineering is generally a skill set required as part of this expertise and therefore these clusters are becoming foci for Systems Engineering within the UK. Figure 5 below indicates some of these clusters that are becoming recognised both by industry, through attractive further companies such as Small and Medium-sized Enterprises in related subjects, and also by government, for example as part of industrial policy.

Figure 5: Some emerging industrial UK Centres of Excellence in Systems Engineering and dominant industries

This figure has been informed by the UK Government's industrial strategy which was published in June 2025 [12]. This publication provides a summary of the geographical disposition of sectors such as:

- Advanced Manufacturing
- Creative Industries
- Life Sciences
- Clean Energy, including Nuclear
- Defence
- Digital and Technologies, including AI
- Professional and Business Services

- Financial Services
- Foundational Industries.

Systems Engineering plays into several but not all of these sectors, but also into other sectors such as transportation, civil engineering and infrastructure, and into healthcare.

Clusters of industry where significant numbers of systems engineers are concentrated are indicated in Figure 5 are:

Shipbuilding on the Clyde and Barrow-in-Furness supported by local universities etc.

Aerospace centred upon Warton and Bristol

Nuclear in North-West England, Midlands, and Berkshire/ Southern Oxfordshire

Automotive centred upon Oxfordshire, Warwickshire, Birmingham and Coventry

Rail centred upon Derby together with Birmingham University

Defence centred upon Bristol, together with Farnborough and Portsmouth

Civil engineering centred upon London and the Thames corridor towards Reading.

It is likely that further such clusters will form as the UK increases its national industrial capability and transformative capabilities such as concern green energy generation and distribution, nuclear fusion, advanced pharmaceuticals, and national infrastructure renewal take shape. Such clusters are likely to form around one or more major employer, universities and research centres and facilities.

Vision for Systems Engineering in the UK

Systems Engineering in the UK has a long history from its inception before World War II and in significant part through its application initially in the domains of aerospace and defence. Through participation in INCOSE as the international professional body for Systems Engineering, Systems Engineering in the UK has been able to draw upon wider (predominately, but not solely, US) understanding and experience but has also been able to contribute to this wider understanding. This contribution has included editing and contributing to the foundational ISO/IEC/IEEE 15288 international standard [ref 2], providing input for the INCOSE Handbook [ref 4] and many other professional publications, and also providing leadership (including individuals who have held the office of president) to the international professional body.

Since the formation of the UK Chapter of INCOSE, the application of Systems Engineering in the UK has broadened from its traditional domain of defence and aerospace to encompass transportation (especially rail), construction and the built environment, nuclear (including civil nuclear power), and healthcare. This broadening continues with issues such as sustainability coming to the fore, especially with younger generations of systems engineer. IfSE intends to continue this broadening and to harness and support systems engineers in these and other emerging challenges. The inter-connectedness of many issues is also increasingly recognised and that addressing them in a piecemeal manner is accepted as inappropriate.

Through this wide engagement and broad application of Systems Engineering, it is evident that there are many commonalities with international practice but also some key distinctions. UK practice has a long tradition of using Systems Thinking techniques (pioneered by key individuals from Peter Checkland to Dave Snowden) to understand the problems being addressed and to help ensure that the right problem is being 'systems engineered'. UK practice in system safety has often been more rigorous and demanding than international practice (for example in the introduction and usage of safety cases as a result of experience gained in North Sea oil and gas exploration and exploitation). In other areas UK policy and practice has tended to be more succinct and precisely codified (perhaps as exemplified in the short 'Don't Panic Guides' and introductory Z Guides as devised by INCOSE UK and now IfSE).

Thus, whilst many aspects of Systems Engineering in the UK are closely aligned with international practice there are areas of distinctiveness in UK practice. The vision for Systems Engineering in the UK remains one of collaboration with relevant international bodies including most importantly INCOSE, but also retaining and where appropriate strengthening its distinctiveness where this is beneficial to UK (and potentially, international) practice.

IfSE intends to be a diverse and inclusive organisation. This is both (1) the right thing to do and also (2) an economic necessity as the UK aspires to regenerate its industrial capability and is faced with both needing to increase numbers of scientists and engineers, including a growing demand for Systems Engineering, and to counter the demographics of significant numbers of existing systems engineers approaching retirement. This will require concerted action from across government, industry, academia, training providers and IfSE itself, if the talent pipeline is to be expanded to meet this burgeoning demand. IfSE intends to be at the forefront of developing professional systems engineers in the UK and also in engaging across the wider engineering profession, including the RAEng, Engineering Council and other PEIs in promoting and realising capability in Systems Engineering in the UK.

Assessment

IfSE is the professional home of Systems Engineering in the UK and traces its origins back to the early days of professionalising the discipline in the UK. It supports a growing professional base of practitioners in the UK and contributes to, and draws upon, international practice including standards. Systems Engineering in the UK is applied to a growing spread of application domains with major geographical centres of Systems Engineering gravity and excellence becoming evident, serving the needs of government and industry and allied to education and training providers.

Demand for systems engineers is growing markedly as the UK re-industrialises and recognises that many issues need to be addressed in a more joined-up manner. IfSE is at the heart of understanding this need and coordinating action across government, industry, academia and training providers. It recognises the need to engage with and draw upon a wide and diverse base of talent within the UK and to make the profession of Systems Engineering increasingly inclusive.

Whilst being a significant contributor to international best practice in Systems Engineering, it is also evident that the UK has some distinctiveness of character in its Systems Engineering practice. IfSE will both continue to contribute to international practice whilst also retaining and developing this distinctiveness to the benefit of UK and other practitioners.

Systems Engineering Professionalism in the UK

IfSE as the Professional Engineering Institution for Systems Engineering in the UK

In the UK the Engineering Council grants licences to Professional Engineering Institutions (PEIs), allowing them to assess candidates for inclusion on the national register of professional engineers and technicians. PEIs cover the whole breadth of the engineering profession, with 40 such institutions currently being recognised. Some are also licensed to accredit or approve degrees, professional development schemes, qualifications or apprenticeships. The scope of individual PEIs is varied with some being focused on application domains and others on specialist disciplines and considerations.

The Engineering Council governs the PEIs and the PEIs, in turn, determine whether individuals and learning programmes meet required standards, and monitor whether individuals continue to sustain professional development and adhere to codes of professional conduct.

Within the UK the Institute for Systems Engineering is the recognised PEI for Systems Engineering with a growing range of licensed responsibilities and powers as are elaborated below.

Systems Engineering Registration

Over the past 15 years, IfSE has been on a path to becoming a fully licensed member of the Engineering Council. As far back as 2011 surveys of our membership revealed a demand for a route to attain Professional Registration status. In response, the role of Professional Development Director was introduced to the Council and work began to establish an affiliate partnership with the Institution of Engineering and Technology (IET). By October 2011, an agreement was formalised with the IET. This marked the start of a cost-effective pathway for our members to achieve Chartered Engineering (CEng), Incorporated Engineers (IEng) and Engineering Technician (EngTech) status.

By June 2012 we worked with seven prominent Systems Engineering employers (ATKINS, BAE SYSTEMS, General Dynamics UK, Purple Secure Systems, QinetiQ, Thales UK and Ultra Electronics) to create a pathway for employees to stand out from the competition by achieving Professional Registration. The '1st Movers' initiative was announced. The companies within the 1st Movers nominated pioneering candidates for professional registration and by November 2012, 18 individuals were awarded Chartered Engineer status, affirming the soundness and functionality of the professional registration process.

In June 2016, we had concluded our professional registration agreement with the IET and explored the opportunity of partnering with the Society of Environmental Engineering (SEE). The new arrangement with the SEE provided IfSE with more exposure to the registration process and the opportunity for our members to become trained Professional Registration Assessors. This meant that for the first time,

applicants were assured that their competence would be assessed by trained systems engineers who fully understood their experience and underpinning knowledge.

Building on the experiences and knowledge gained from collaborations with the IET and SEE, we sought full licensing as a Member of the Engineering Council. On 7th February 2020, this became a reality as we secured approval as a Licensed Member of the Engineering Council as part of the Joint Registration Board (JRB) with the Institute of Explosive Engineers (IExpE). This allowed us to be able to assess applicants for the National Register of Professional Engineers and Technicians as CEng, IEng or EngTech.

Since January 2021 our membership has grown by 69% from 1004 to 1700 members (as of Sep 2025). In the same period our professional registered members have grown by 264%; from 37 to 98. While we remain a small PEI, our growth of professional registered members should be seen as a big success when set against the wider backdrop of falling numbers of engineering registrants generally. The total number of registrants has fallen 3% over the period 2018 to 2024 (Figure 6). This is a significant achievement and has been enabled through the enormous efforts made by all of our volunteer assessors and advisors.

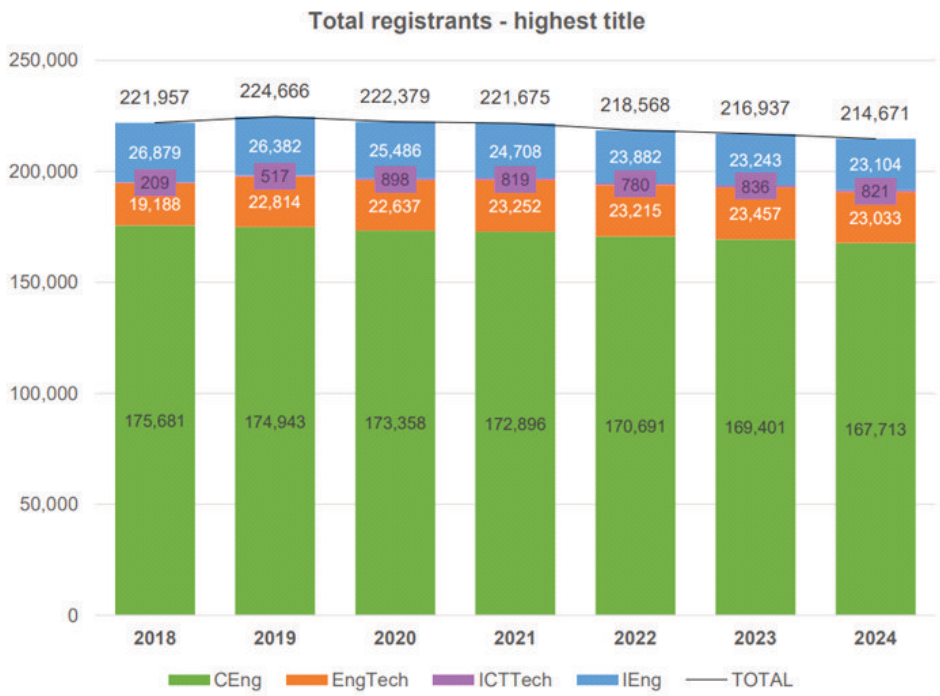

Figure 6 - Total Registrants per year (reference: 'Engineering Council Annual Registration Statistics 2024: Summary')

In August 2020 the Engineering Council published the UK Standard for Professional Engineering Competence and Commitment (UK-SPEC), 4th edition [13]. The changes between the previous 3rd and current 4th edition were subtle and primarily made to clarify the competency and commitment requirements. However, the 4th edition broadened the scope of the evidential requirements in favour of System Engineering; specifically in the '*B Competency - Design, development and solving engineering problems'*. These changes included a greater emphasis on the identification and definition of project requirements (B1) and the recognition of "*engineering tasks*" rather than an "*engineering solution*" (B2 and B3). The Engineering Council are commencing a Standards Review consultation process in 2026 and IfSE will be involved

in shaping the future direction of the Engineering Council Standards and contribute to their development. This is likely to result in a new edition of UK-SPEC.

In January 2025 the Engineering Council awarded IfSE a 5-year extension to our licence. This put us on a firm foundation for our future aspirations. We have already begun discussions with the Engineering Council to examine how go about extending our licence into areas such as accreditation of Higher Education programmes, Level 6 and 7 apprenticeships or work-place training schemes.

Systems Engineering Certification

In 2012, IfSE (formerly INCOSE UK) formed an Internal Agreement with INCOSE that allows us to locally administer the INCOSE SEP certification process. The UK developed its own in-house SEPs online application system in 2015.

Since 2021, our SEP-certified members have grown by 91% from 249 (Jan 2021) to 477 (as of Sep 2025). This level of growth has broadly kept up with our membership in the same period.

Approximately 25% of UK members hold some level of SEP certification. This compares well against INCOSE global membership where 18% hold a SEP qualification based on the INCOSE Annual Report 2024 [14]).

Of UK SEP-certified members we have a higher percentage of ASEPs (69% of all UK Certified Members are ASEP) compared to INCOSE global membership where 40% are ASEP [ref 14]. There has been very strong demand in the ASEP qualification over recent years, and this may be attributed to two factors:

- ASEP is likely perceived as a ‘stepping-stone’ qualification for early career members looking to further their career and eventually progress towards professional registration, specifically CEng, noting that employers have an expectation of certification and/or Chartership of engineers working for them.
- ASEP has been used as a second or tertiary qualification to show a level of competency and awareness of System Engineering principles for those who would not consider themselves primarily a system engineer.

In 2024 INCOSE moved to online exams. This transition has provided greater flexibility for our members to take the SEP’s knowledge exam. However, we have also seen the rise of paper-based exams requests, specifically for organisations with larger SE communities.

In 2024 Queen Mary University became the first in the UK to attain academic equivalence, meaning that students who have completed specific modules are eligible for the ASEP qualification. Loughborough University and the University of Strathclyde are also in the process of applying for academic equivalence.

IfSE has put into place Student member-discounted rates for UKAB universities and those who hold academic equivalence. By subsidising Student membership we are

seeking to provide greater support to students by facilitating more cost-effective access to the IfSE and INCOSE library of technical material.

IfSE is looking to work with INCOSE to examine opportunities to better integrate the UK Professional Registration and SEP's Certification services. This is in the early stages currently, but options could include CSEP recognition/equivalence to the IEng and/or CEng titles or potentially accrediting the SEP knowledge exam as partially meeting the learning outcomes of Further Learning.

Career Paths in Systems Engineering

The idea of recognised career paths supporting those wishing to pursue a career in Systems Engineering is still not well-established. This probably reflects the relative infancy of the profession as well as the diverse nature of those who take up such a career. However, career opportunities in Systems Engineering for those from a variety of disciplines are increasing, directly reflecting the increasing complexity and inter-dependence of the many systems and associated services which now rule our lives. Systems Engineering competence is also useful for those individuals seeking senior positions in industry or Government service such as policy advisers and technical directors.

Whilst Systems Engineering qualifications at graduate and post-graduate levels have been holding steady if not rising in recent years, there are many practising Systems Engineers who do not have formal qualifications specifically in Systems Engineering. Often, they may have a domain-centric qualification or one in another engineering discipline, and many practitioners are not engineering graduates. Note that some employers (e.g. MoD) prefer to recruit from a traditional engineering degree and then train in SE at postgraduate level. Indeed, whilst recognition of the discipline is now much more widespread, some employers still do not recognise the role of 'Systems Engineer' even if they do fully recognise the need to perform Systems Engineering. For some individuals, being classified as a systems engineer would probably be an anathema since they would not feel themselves to be an 'engineer' or as working on a 'system'. There are also those who feel their role as 'designer' includes (as a subset of role) Systems Engineering skills that apply to part, but not the whole, of their job, and may feel that the Systems Engineering title weakens their role description. These complexities further complicate the career path debate.

However, some patterns do emerge and these are worthy of note. For those performing 'Systems Engineering' as their day job, backgrounds often include physics, mathematics, operational research, a wide range of other sciences notably the cognitive sciences, biological sciences and system operation as well as a full range of engineering disciplines. Having foundational competence in these other areas and breadth of experience serves the Systems Engineering community in the UK well. Specific employers can attract people from different relevant backgrounds and meld them into a coherent systems capability.

For the future, the ever-increasing complexity of systems spanning multiple non-traditional disciplines and with increasing socio-economic aspects will tend to widen

the opportunities for 'Systems Engineering' as a career path. This is already apparent in the utilities and infrastructure sectors, for instance.

Early Careers and Systems Engineering

Given that Systems Engineering is only presently taught as a first-degree course at a limited range of UK Universities (Warwick, Greenwich, and Exeter), it is important to understand how to develop and support systems engineers in their early careers. This is even more necessary given the growing demand for systems engineers and the demographic of existing systems engineers which indicates that significant numbers of experienced systems engineers will leave the profession through retirement over the next 10 years or so.

Significant numbers of recruits with the right sorts of aptitudes need to come into Systems Engineering. These can be gained by drawing upon a diverse range of individuals from a potentially broad range of experiences and development. Potential paths into Systems Engineering from other disciplines, both within engineering and more widely, from other communities such as 'system users', and also from 'unconventional' backgrounds such as science and the arts need to be better understood and recognised. Work is underway (sponsored by the UKAB) to do this. Educational institutions, training providers, employers and IfSE as the professional body for Systems Engineering in the UK all have parts to play in developing early careers to 'fully-fledged' future systems engineers.

Diversity and Inclusivity and Systems Engineering

A diverse population has a high chance of members possessing different ideas, experiences, and abilities, but it is only inclusive if every member feels welcome and valued regardless. The term "D&I" encompasses the idea of embracing difference and giving everyone a voice that can be heard.

Systems Engineering is diverse by nature; in the domains in which it is employed, the tasks engineers undertake, and the set of stakeholders involved with a system. A successful system considers the needs of all stakeholders to produce solutions of best compromise, requiring diverse perspectives. However, the benefits of diversity cannot be harnessed without inclusion. Thus, in recent years IfSE Members have established a D&I Committee, which reports to the IfSE Council. It began as a UKAB Collaboration Group in October 2023, primarily to produce recommendations for escalation to the Council. A combination of the group's achievements and growth resulted in their transition to a formal committee in March 2025, with seven elected members from various engineering sectors across the UK. The committee exists to promote, encourage and support diversity and inclusion, not just within IfSE; but the whole of Systems Engineering and adjacent communities.

Future work planned by the committee will address the two major D&I issues faced in the current Systems Engineering landscape: growing and diversifying the future pipeline of engineers, and retaining those already in the field.

The former issue is partly due to the widening resourcing gap observed across engineering domains, evidenced in analysis conducted by both EngineeringUK [15] and the RAEng [16]. The reports reveal that the demand for engineers has accelerated beyond reach of the current supply, largely because of rapid evolution within the technological landscape. Both EngineeringUK and the RAEng concluded that without changing our approach to engineering education and recruitment, the talent shortage will only continue to worsen, leaving industry needs unmet.

The latter issue with retention can be observed in the statistics presented by EngineeringUK in May 2024 [17], which revealed that the proportion of women in engineering and technology roles across the UK had fallen from 16.5% to 15.7%, with the largest drop amongst those aged 35-44. This decline was not mirrored in other careers, raising questions about what factors are causing drops amongst certain demographics.

The issues discussed above highlight that now is a crucial time to implement D&I initiatives, in parallel. For example, diversity could be encouraged through outreach targeted at marginalised communities that have previously been excluded from the profession, or early education to defeat stereotypes and reframe engineering as a career that anyone can pursue. However, diversifying the future pipeline will only prove useful if efforts are made to reduce the rate at which people are leaving. This may include implementing inclusive practices to help engineers feel content in their role and keen to remain in the field, regardless of how they identify. Influencing attitudes can be arduous, however, continuous and frequent acts of inclusion, from awareness days to workshops, can have a cumulative effect.

In summary, IfSE recognises that D&I benefit everybody. The D&I Committee will continue its efforts to both facilitate the diversification of future generations of engineers, and to increase accessibility of Systems Engineering so as to retain diverse talent.

Professional Groups in Systems Engineering

IfSE has a range of professional groups serving a variety of purposes. Some serve as forums to exchange professional information and to network with like-minded individuals with similar concerns and interests. Others serve a more formal purpose to disseminate information, contribute to wider initiatives such as the development of international practices and standards, and to codify good practice nationally. These professional groups report in variously to the IfSE Technical and Outreach Directors.

Currently constituted professional groups comprise:

Forums

- Early Careers Forum

Committees

- Diversity and Inclusivity

Working Groups

- UK Defence
- Agile Systems Engineering
- Architecture
- Model Based Systems Engineering
- Quantum Systems Engineering
- Service Systems Engineering
- Systems Engineering and Project Management

Interest Groups

- Automotive
- Energy Systems
- Railway

Collaborative Working Groups

- Safety
- Security

Local Groups

- South West
- Midlands
- London
- North West
- Scotland
- South Coast

Some of these groups are more active than others. Other professional groups form, cease and even reconstitute as needs arise.

Continuing Professional Development in Systems Engineering

Continuing Professional Development (CPD) is defined as "*A structured approach to learning to help ensure competence and practice, taking in knowledge, skills and practical experience. CPD can involve any relevant learning activity, whether formal and structured or informal and self-directed*". IfSE believe that CPD is an essential activity

for every individual who is practising Systems Engineering, whether or not they hold professional registration or SEP Certification.

What qualifies as CPD is broad and while it can comprise formally taught courses or qualifications it can also include any of:

- Workplace Training schemes
- Work Experience
- Academic Study
- Volunteering
- Mentoring/Coaching
- Events and Seminars
- Self-Study.

Both Professional Registration and SEP Certification require CPD to be undertaken and recorded, but in different ways.

For Professional Registration, the Engineering Council places the emphasis on the individual planning their CPD requirements based on their own career objectives. There is no minimum threshold for time or units/credits but a guideline of 30 hours a year is advised. Learning through CPD should be reflective and should relate back to the individual's objectives. Professional Registered members are subject to an annual sample review of their CPD.

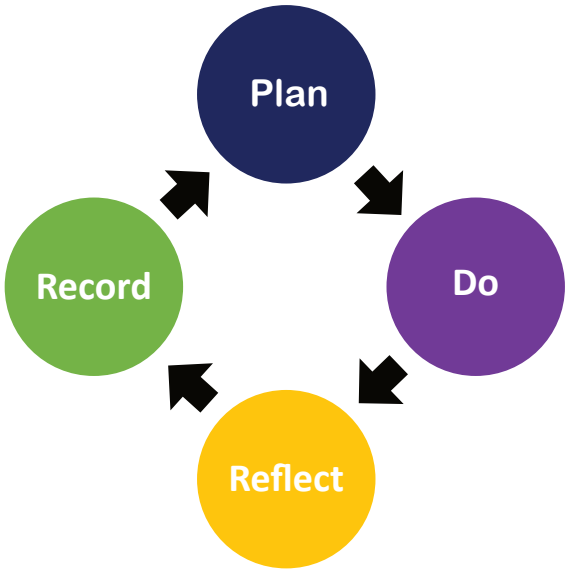

Figure 7 - CPD Plan>Do>Reflect>Record cycle

For SEP Certification, submitting a CPD record is required when renewing either ASEP or CSEP qualifications. Types of CPD are categorised and given Professional Development Units and there is a requirement to achieve a minimum of 120 PDUs within the 3 or 5-year period of SEPs qualification.

Training Provision in Systems Engineering

Major employers of systems engineers together with a number of specialist training providers provide training in Systems Engineering and related subjects such as Systems Thinking, particular techniques, and MBSE tools and notations. Universities also offer short courses, often these are modules or devised from modules provided as part of degree or apprenticeship courses.

Such training provides significant opportunity for right-skilling and upskilling Systems Engineering practitioners particularly in the specific areas of knowledge and technique they need to undertake practical work.

IfSE endorses training providers by undertaking a rigorous assessment thereby ensuring that proffered training programmes meet high-quality, industry-aligned standards in Systems Engineering. Currently the endorsed training providers are:

- Burge Hughes Walsh
- Optimise Engineering
- Scarecrow Consultants
- Systems Engineering Training
- Edinburgh Systems
- School of Systems Engineering
- Engineering Systemisers (UCL)

In the future IfSE is likely to offer the accreditation of training programmes in Systems Engineering such as those provided by major employers.

Research in Systems Engineering

University education in Systems Engineering and related subjects is underpinned and extended into research in the field. Significant research is also undertaken by specific organisations e.g. within industry to both improve practices and increase their efficiency.

Research collaboration takes place both nationally within the UK (e.g. within IfSE working groups, through industry-academia partnerships) and internationally (often being coordinated by INCOSE and its international working groups or through academic partnerships).

Research in Systems Engineering at corporate, national and international levels is important given the increasing pervasiveness together value-add potential of the discipline. It is evident that certain nations, probably most notably the United States and France, have very active research programmes in Systems Engineering. An example of one of these is the Systems Engineering Research Center (SERC) which is a university-affiliated research centre of the US Department of Defense (DoD) that leverages research and expertise of faculty, staff, and students from more than 20 collaborating universities.

Within the UK it is difficult to catalogue areas of active research in the field as some are commercially-sensitive but discernible areas of Systems Engineering and related research include:

- Application of Systems Engineering to particular domains
- AI and Systems Engineering
- Cyber-Physical Systems
- Engineering Autonomous Systems
- Model-Based Systems Engineering
- Quantum Systems Engineering
- System of Systems Engineering
- Systems Engineering and Digital Engineering
- Systems Engineering Management
- Systems Thinking and its Application.

IfSE Systems Engineering Publications

The corpus of published information on Systems Engineering theory and practice has mushroomed in the years since the publication of seminal texts such as Hall [ref 3]. Nevertheless, the practitioner remains confronted with a bewildering amount of professional guidance to consider, much of which is of varying applicability or quality.

Throughout its existence as IfSE (and previously INCOSE UK), the UK Systems Engineering community has contributed to international practice including INCOSE (i.e. international) publications and international standards. Its members have also authored leading textbooks in the field.

IfSE has also been proactive in devising a range of professional publications, ranging from high-level guidance, through short introductory textbooks, white papers, the competency assessment framework, more detailed textbooks, conference proceedings, professional magazines to, most recently, a practitioner journal. The publishing of such material is a key part of IfSE's role as a professional body and enables its members to be increasingly well-informed on professional matters, supports their practice, and contributes towards helping to maintain an individual's currency and proficiency in Systems Engineering. IfSE has taken significant steps to increase the accessibility of its publications in accordance with its D&I policy through measures such as adopting off-white paper tones, layout improvement, font selection and size, etc.

The range of professional publications which IfSE publishes comprises:

Don't Panic! - The Absolute Beginners Guide to Architecture and Architecting

Don't Panic! - The Absolute Beginners Guide to Architecture Framework

Don't Panic! - The Absolute Beginners Guide to Model-Based Systems Engineering

Don't Panic! - The Absolute Beginners Guide to Managing Interfaces

Don't Panic! - The Absolute Beginners Guide to Service Systems and Services

Don't Panic! - The Absolute Beginners Guide to Agile in Systems Engineering

Don't Panic! - The Absolute Beginners Guide to Systems Thinking

Don’t Panic! - The Absolute Beginners Guide to SysML v2

Don’t Panic! - The Absolute Beginners Guide to Configuration Management

Don’t Panic! - The Absolute Beginners Guide to System Integration and Test

Don’t Panic! - The Absolute Beginners Guide to SysML v2 - German Translation

Don’t Panic! - The Absolute Beginners Guide to SysML v2 - Japanese Translation

Don’t Panic! - The Absolute Beginners Guide to Model-Based Systems Engineering - Japanese Translation

Advanced Application in Systems Engineering - Implementing MBSE into Your Business - The Trinity Approach

Adventures In Systems Engineering

TeamStorming

Think Engineer

Annual Systems Engineering Conference - Proceedings 2018 - 2025

Practical Systems Engineering Journal 2025 - Agile in Systems Engineering

Capability Systems Engineering Guide

Agile Systems Engineering Guide

Architects Manifesto for Development of Systems Engineering

Introduction to Systems Architecting

UK Systems Engineering Competency Framework

Z Guide Bundles

U Guides

Omega Guides

SEASON Reports 2009, 2014, 2020

Presenting The Institute for Systems Engineering

Assessment

IfSE is the licensed UK Professional Engineering Institute for Systems Engineering and is progressively discharging more of the full range of professional responsibilities in this discipline. It maintains the register of Engineering Council registrants, certifies systems engineers for proficiency in Systems Engineering against internationally-recognised (INCOSE) standards, ensures registrants sustain their professional development, and accredits training providers in Systems Engineering. IfSE is likely to accredit Systems Engineering degree programmes and apprenticeship schemes moving forwards.

IfSE recognises different entry points into Systems Engineering including as both initial and secondary careers and supports a thriving early careers community. It also supports various committees and groups thereby enabling systems engineers to address common concerns and interests, to acquire current knowledge, and to network with like-minded individuals. Professional groups include working groups, interest groups and (geographically) local groups. Many of these committees and

groups constitute a primary means by which IfSE members engage with, and contribute to, the PEI.

IfSE supports its membership development in the profession of Systems Engineering through means including monitoring continuing professional development, endorsing training providers to ensure that they deliver appropriate and authoritative material, and through publishing a wide and increasing range of professional publications which are commercially available. It also monitors relevant research being undertaken in Systems Engineering within the UK and, through its working and interest groups, engages with corresponding groups internationally in INCOSE together with corresponding groups in other UK PEIs and professional organisations. These measures help IfSE to discharge its professional responsibilities and to be aligned with, and contribute to, the development of Systems Engineering internationally together with the broader field of engineering within the UK.

In the future IfSE will need to consider whether it is able to expand the range of professional services it provides to members such as, for example, in extending its advertising of job opportunities to include support in writing CVs and in successful interviewing.

Systems Engineering and Academia

Academic Activity within the UK

This section covers education and research undertaken in UK academic institutions. Undertaking these activities is critical to the continued development of Systems Engineering and provision of recruits into and advanced practitioners in industry. Their status provides a good 'litmus' test for the overall health of the discipline.

One difficulty in setting out the status of Systems Engineering in academia is that the subject addresses a range of fundamental issues and can therefore be found as a component of many broader courses, including science and engineering courses, computing courses and even business courses. This is particularly evident if related subjects, such as Systems Thinking, are included within its scope. Hence, attention is focused primarily on 'specialist' Systems Engineering education and research.

Those with academic affiliations are already well represented in the membership of IfSE, including individual members and corporate members. An informal survey of the IfSE membership indicated that just under 5% of members are associated with an academic institution. In total, 3.5% of the membership comprises student members. In addition, many industry-affiliated members also hold Visiting Fellowships or Professorships, or have other connections with specific universities including participation in industrial advisory boards.

There are currently three Academic institutions belonging to the IfSE Advisory Board:

- Loughborough University
- University of Strathclyde
- University College London (UCL)

Such organisations feature strongly in the provision of education and training in Systems Engineering, as well as being active in Systems Engineering research.

The IfSE Council includes an Outreach Director who has responsibility for academic engagement. Engagement with academic institutions includes:

- Engagement with Advisory Board representatives
- Direct engagement
- Forming regular contact between Student Ambassadors at universities and members of IfSE's Early Careers Forum (ECF)

Systems Engineering Education

Reviews of UK engineering generally indicate the importance of engineering to the UK economy, shortages of people who are interested in joining the profession and entering this sector of industry, and an ageing of the demographic of those employed in engineering. Within Systems Engineering this is perhaps exacerbated by three further factors:

- Whilst systems approaches may be taught as part of the curricula for several school academic subjects, Systems Engineering is unlikely to be mentioned
- Few systems engineers are formally taught in the discipline resulting in most practitioners learning by doing 'on-the-job' supplemented by training course attendance
- Many systems engineers join the profession as a 'second career' having either cut their teeth in another technical discipline or having come from a user community such as the UK Armed Forces.

The entire pipeline from schools, through universities and other disciplines which lend themselves to developing systems engineers (or at least making them aware of its existence and utility) needs to be considered if the supply of systems engineers is not to remain problematic. The various stages of this pipeline as relate to Academia are considered in turn below.

Secondary Education

Historically there has been a mismatch between supply and demand in Science Technology Engineering and Mathematics (STEM) skills generally, with demand outstripping supply in the engineering professions and across the whole economy. Some improvement in this situation has occurred since 2018 onwards with increases in the numbers of students studying specific STEM subjects at GCSE level, we can see a clear gradual positive trend in numbers from 2018 to 2024 [10], [11]. This situation is encouraging but needs to translate into increasing numbers of students wishing to take STEM subjects at university or complete apprenticeships, and who envisage and are attracted to careers in industry (or Government or academia).

Higher Education

In higher education the Engineering Council's accreditation requirements, Accreditation of Higher Education Programmes (AHEP), [18] have a strong influence on course design. Positively for Systems Engineering, the need for an integrated or systems approach to engineering problems is recognised, as are many other factors that would normally be thought of as core to Systems Engineering (such as the need to understand business and stakeholder needs, as well as effective communications with non-specialists).

AHEP 4 (published 2020) is a strong development for Systems Engineering education accreditation because it embeds **Systems Thinking** directly into accredited learning outcomes. It requires engineers to **apply integrated, systems-level approaches to complex problems**, aligning closely with modern SE practice. Its set of 18 outcomes brings clarity, ensuring programmes cover technical subjects alongside **security, risk, sustainability, ethics, communication, and multidisciplinary teamwork**. This supports real-world Systems Engineering, where social, technical, and organisational factors must be managed together. AHEP 4 also strengthens alignment with **IEng/CEng**

professional expectations and includes modern themes like **security and inclusion**, keeping SE curricula relevant. [20], [21].

Many of the better Systems Engineering programmes are accredited by Professional Institutes such as the IET. Each Institute undertakes a regular review of the curriculum and the environment in which programmes are taught. This means that graduating students will have attained the educational standards for Chartered or Incorporated Engineer.

Undergraduate Education

At undergraduate level a search of the Universities and Colleges Admissions Service (UCAS) and other websites reveals the following bachelor's courses with 'Systems Engineering' in their titles:

- University of Exeter – BEng Systems Engineering
- University of Greenwich – BSc (Hons) Systems Engineering
- University of Warwick – BEng Systems Engineering

Devising lists of courses with Systems Engineering content as recognised by IfSE is not straightforward. This is because some courses with significant Systems Engineering content, such as Aerospace Engineering courses at several universities do not have 'Systems Engineering' in their titles. Conversely, many courses have 'Systems Engineering' in their titles but their take on the subject is very specific such as relates to electronic systems, computer systems, digital systems, network systems, and embedded systems.

- Bangor University – BEng Computer Systems Engineering
- Brunel University London – BEng Computer Systems Engineering
- Middlesex University – BEng Computer Systems Engineering
- Queen Mary University of London – BEng Computer Systems Engineering
- Royal Holloway, University of London – BEng Computer Systems Engineering
- University of Bath – BEng (Hons) Computer Systems Engineering
- University of East Anglia – BEng Computer Systems Engineering
- University of Essex – BEng Computer Systems Engineering
- University of Sheffield – BEng Computer Systems Engineering
- University of Warwick – BEng/BSc Computer Systems Engineering
- University of Sunderland – BSc (Hons) Computer Systems Engineering (Top-Up)

Those that are more electronics-focused comprise the following:

- Cardiff Metropolitan University – BEng/BSc Electronic and Computer Systems Engineering
- London South Bank University – BEng/BSc Electronic and Computer Systems Engineering
- University of Portsmouth – BEng (Hons) Electronic Systems Engineering (Top-Up, Distance Learning)

- Glasgow Caledonian University – BEng /BEng (Hons) Digital Systems Engineering
- UWE Bristol – BEng/MEng (Hons) Digital Systems Engineering
- University of East London – BEng Mechatronics and Computer Systems Engineering
- University of Sunderland – BSc (Hons) Network Systems Engineering (Top-Up, incl. study centres)

Those that are robotics and embedded systems focused comprise the following:

- Aberystwyth University – BEng Robotics and Embedded Systems Engineering
- Aberystwyth University – BEng Robotics and Embedded Systems Engineering with Industrial Year

There are 23 establishments offering undergraduate courses with Systems Engineering in their title. Of these 20 might be regarded as solely offering domain-centric SE courses. There are numerous courses that provide exposure to a related topic (e.g. Systems Thinking) or a domain specific focus (e.g. energy systems), which we have not attempted to quantify in this SEASON Report.

Only 3 universities presently offer domain-agnostic 'Systems Engineering' courses and of these only 2 (University of Exeter, University of Warwick) are presently approved (as of the time of publication of this Report). These courses may be viewed as providing a mix of Systems Engineering and related disciplines.

Apprenticeships

In general apprenticeships are available at a variety of levels. Level 7 is equivalent to a Master's degree, Level 7 NVQ, PGCSE or a Postgraduate Certificate. Level 6 Systems Engineering – which has been supported by IfSE members as part of the Trailblazer group and was approved by IfATE (now renamed Skills England) in March 2025; this requires completion of the assessment plan and review for funding during 2026 before it becomes available for recruitment and delivery. Level 3 apprenticeships are generally considered to be equivalent to two A-level passes.

Those concerning Systems Engineering are available at the following levels:

- Level 7 Systems Engineering Masters Apprenticeship (SEMAP) – this has been run since 2015 and has been the baseline UK education for up-skilling Systems Engineering practitioners and developing leadership skills
- Level 7 Systems Thinking (and Leadership) Practitioner which was approved in 2020
- Level 6 Systems Engineering – which has been supported by IfSE members as part of the Trailblazer group and was approved by IfATE in March 2025
- Level 6 Aerospace Systems Engineering (degree)
- Level 6 Embedded Electronic Systems Design and Development Engineer (degree)

- Level 6 Rail and Rail Systems Senior Engineer (integrated degree)
- Level 6 Space Systems Engineer (degree)
- Level 6 Control Systems Engineer (degree)

Several universities offer the Level 7 SEMAP apprenticeship, currently:

- Cranfield University
- Loughborough University
- University College London

Universities offering the Level 7 Systems Thinking Practitioner apprenticeship are:

- Birmingham University
- Cranfield University
- Leeds Trinity University
- University of Exeter
- University of Strathclyde

In March 2025, the Department for Education (DfE) announced that levy funding would no longer be available for level 7 apprenticeships for people over 21, with some minor exceptions, and that industry would be expected to pay the full cost of L7 apprenticeships. The prospects for the above programmes are, therefore, uncertain.

A number of institutions are considering offering the Level 6 Systems Engineering apprenticeship, but each will have to make a business case to gain approval by senior management. The fee for this apprenticeship has not yet been published by Skills England. With most academic institutions currently facing significant financial challenges, it is unclear at present how many, and which, will establish level 6 apprenticeship programmes in Systems Engineering.

IfSE accreditation of degree courses and apprenticeships

As part of its licence IfSE is able to accredit degree courses and apprenticeships. Whilst it presently does not exercise this responsibility it is likely to do so moving forwards as part of the ongoing professionalising of Systems Engineering within the UK.

Postgraduate Education and Research

At postgraduate level there is a healthy selection of specific Systems Engineering and closely related courses resulting in MSc, PhD, EngD or other qualifications. Providers of masters-level Systems Engineering courses in the UK (together with the particular course offerings) comprise:

- Cranfield University – MSc Systems Engineering – MSc
- Loughborough University – MSc Systems Engineering – MSc
- University of Portsmouth – MSc Systems Engineering – MSc
- UCL – MSc Systems Engineering Management – MSc
- University of Strathclyde – MSc Systems Engineering Management – MSc

- University of Bradford – MSc Satellite Systems Engineering – MSc
- University of Bolton – MSc Systems Engineering (Mechanical) & Engineering Management – MSc
- University of York – MSc Digital Systems Engineering – MSc
- University of Leeds – MSc (Eng) Embedded Systems Engineering – MSc (Eng)
- Coventry University – MSc Embedded Systems Engineering – MSc
- University of Glasgow – MSc Computer Systems Engineering – MSc
- University of Surrey – MSc Process Systems Engineering – MSc
- University of Oxford (Continuing Education) – Systems Engineering Fast-Track – Short Course (CPD)

Masters-level courses are available from a number of universities, however the SEMAP qualification has gained significant traction as a baseline course. The relative preponderance of higher degree courses, as compared to first degree courses, suggests that Systems Engineering is seen as a subject that is difficult to teach at undergraduate level (although seemingly successful approaches in the US counter this position) and a profession that is best entered after gaining work experience. An alternative explanation is simply that students do not gain exposure to Systems Engineering at school and therefore do not opt to take Systems Engineering degrees.

Many universities have well-established Industry Advisory Boards, providing input to curriculum development. Some use Visiting Fellows and Professors amongst their teaching staff to ensure experience from current practice is reflected directly in the delivery.

UK Research and Innovation (UKRI) is the largest funder of PhDs in the UK, providing studentships through the seven Research Councils, principally the Engineering and Physical Sciences Research Council (EPSRC) and the Economic and Social Research Council (ESRC) concerning systems approaches.

Centres for Doctoral Training (CDTs) and Doctoral Training Partnerships (DTPs) are how UK Research Councils fund PhD students. CDTs are collaborations between universities and industry partners that provide structured PhD training. Funded by UKRI, CDTs offer fully-funded four-year studentships. In some cases, they may even offer an integrated Masters (such as SEMAP) in the first year (also known as a 1+3 programme). DTPs are similar to CDTs in what they offer students but the scope of research at a DTP is much broader. There are still collaborations between universities and industry partners and involve both research and training elements. The EPSRC also fund doctoral training through the DTP and Industrial CASE Studentships (ICASE).

The CDTs funded in the 2019 round were listed in the 2020 SEASON Report [19]. Some of these are now closed; some have had their funding extended. Further CDTs were announced in 2023.

The following CDTs are relevant to systems approaches:

- Future Autonomous Robotic Systems (FARSCOPE-TU: Towards Ubiquity) – University of Bristol
- Geospatial Systems – University of Nottingham and Newcastle University

- Connected Electronic and Photonic Systems – University College London and Cambridge University
- Water and Waste Infrastructure Systems Engineered for Resilience (Water-WISER) – University of Leeds
- Resilient Decarbonised Fuel Energy Systems – Universities of Nottingham, Sheffield and Cardiff
- Autonomous Intelligent Machines and Systems (AIMS) – University of Oxford
- Wind & Marine Energy Systems & Structures (CDT-WAMSS) – Universities of Strathclyde, Edinburgh and Oxford
- Sustainable Chemical Technologies: a systems approach – University of Bath
- Modelling of Heterogeneous Systems – University of Warwick
- Complex Integrated Systems for Defence and Security – University of Southampton
- Cyber Secure Everywhere: resilience in a world of disappearing system boundaries – University of Bristol
- Cyber-physical Risk – University College London
- Cyber-physical systems for Medicines Development and Manufacturing (CEDAR) – University of Strathclyde
- Quantum Technology Engineering – University of Southampton.
- Net Zero Maritime Energy Solutions (N0MES): University of Liverpool and Liverpool John Moores University.
- AI in Decision Making for Complex Systems- University of Manchester
- Sensor Technologies and Applications in an Uncertain World – University of Cambridge
- Formulation Engineering – University of Birmingham
- Quantum Informatics – multiple university partners
- Machining, Assembly, and Digital Engineering for Manufacturing (MADE4Manufacturing) – University of Sheffield
- Fusion Engineering CDT – UKAEA and Universities of Birmingham, Liverpool, Manchester and Sheffield

Additionally, several other CDTs have scope for Systems Engineering training, but do not have ‘Systems’ in their title.

Publicly funded Research

In the following paragraphs, key research centres for Systems Engineering are identified and a brief summary is provided of their research relevant to Systems Engineering. Note that whilst some research is undertaken in DTCs, arguably the greater proportion of research is undertaken by post-doctoral Research Associates, often as part of large projects funded across institutions or internationally.

Birmingham University

Birmingham has several research groups applying systems approaches such as Systems Thinking and Systems Engineering, including:

- Centre for Systems Modelling and Quantitative Biomedicine
- Communications and Electromagnetics
- Electrical Power and Control Systems Group
- University of Birmingham Centre for Railway Research and Education

City University

City University does not have specific Systems Engineering research groups but does consider aspects through its various engineering research centres, including the Research Centre for Civil Engineering Structures focusing on structural integrity, the Research Centre for Fluid-Structure Interaction, and the Research Centre for Multi-scale Geotechnical Engineering.

Cranfield University

The Centre for Systems and Technology Management undertakes research in various areas of Systems Engineering such as resilience, life cycle costing of systems, MBSE, requirements engineering, systems architecture, software and cyber Systems Engineering, autonomy in systems design, human-machine teaming, Systems Thinking, human Systems Engineering, project management/Systems Engineering crossover, and Systems Engineering education.

Imperial College London

The Centre for Systems Engineering and Innovation (CSEI) undertakes research in systems approaches to civil infrastructure. Examining cyber-physical complexity and interdependencies between infrastructure systems in water and transport.

Loughborough University

Loughborough has a number of research groups focusing on Systems Engineering and related topics:

- Systems Engineering and Complexity Research Group
- Intelligent Automation Research Group
- Advanced VR Research Group
- Quantum Systems Engineering Research Group
- Engineering Doctorate Centre in Model-Based Systems Engineering (MBSE).

Queen Mary University of London

QMUL's Centre for Networks, Communications and Systems conducts research into networked systems.

University of Bristol

The Systems Centre at the University of Bristol is developing a far-reaching stakeholder-needs defined research programme rooted in the application of Systems Thinking approaches across a full range of engineering disciplines and sectors.

University College London

UCL's Centre for Systems Engineering undertakes research in several areas including Systems Thinking and engineering, technology management, risk management, and the management of projects.

University of Exeter

Exeter has several research groups and institutes in various areas and applying systems approaches:

- Centre for Systems, Dynamics and Control
- Global Systems Institute
- Living Systems Institute

University of Portsmouth

Portsmouth has one of the longest running Systems Engineering research group established for 30 years.

- Modular electro-mechanical systems and electronics
- Assistive technology
- Computer aided design systems
- Knowledge management systems and computing systems
- Automation, robotics and sensors

University of Liverpool

The University of Liverpool has research in Systems Engineering primarily within the fields of Computer Science and Informatics, focusing on Neuro-symbolic AI and knowledge engineering, which includes developing robust methods for creating and integrating knowledge graphs and ontologies, exploring automated knowledge acquisition, and studying the dynamics and interpretability of knowledge structures.

University of Sheffield

Sheffield has several research groups which include System Engineering topics

- Control and Systems Engineering (School of Electrical and Electronic Engineering (EEE)): This group focuses on control systems, a core aspect of Systems Engineering
- Complex Systems and Signal Processing (School of EEE): This group works on algorithms for complex systems analysis and control, overlapping with Systems Engineering principles
- Dynamics (Department of Mechanical Engineering): This group conducts research on vibration control and smart materials, which often involves complex systems design and integration
- Complex Systems Analysis: This broad area, often linked to complex systems and signal processing, has applications in various engineering and scientific fields

University of Strathclyde

The Engineering Management Research Group developing and promoting approaches to the management of design and engineering in practice and employs tools and methods to aid the development of design and manufacturing engineering theory.

Warwick University

Warwick does not have specific research groups concerning Systems Engineering however it does have a unique partnership, namely the Monash Warwick Alliance, with a partner university in Australia which funds PhD's across Systems Engineering topics for sustainable energy in the aviation industry.

Assessment

The UK faces a persistent and widening gap between the strong national demand for Systems Engineers and the weakness of the early-stage talent pipeline. Despite improvements in STEM participation at school level, Systems Engineering remains largely invisible in secondary education and is rarely presented as a career choice. Only a handful of universities offer domain-agnostic Systems Engineering degrees, meaning most practitioners enter the field by conversion, through other technical disciplines, or as second-career professionals.

While accreditation frameworks such as AHEP 4 now embed Systems Thinking more effectively, undergraduate provision remains limited and inconsistent. Apprenticeships at Levels 6 and 7 help address workforce needs, but forthcoming age-based restrictions may reduce accessibility to Level 7 just as industry reliance on these pathways increases.

Postgraduate courses, CDTs, and research centres form a strong upper pipeline, but this strength cannot compensate for the lack of early exposure. Without coordinated intervention, the UK risks continued shortages that undermine its ability to deliver complex national programmes.

Systems Engineering and the Wider Picture

UK Heritage in Systems Engineering

The UK has its own distinctive heritage in Systems Engineering. The air defence system (sometimes termed the Dowding system) that controlled UK air defence during the Battle of Britain was the first integrated 'networked system' and remains an exemplar of the type. The discipline of Operational Research was developed during World War II to apply Systems Thinking and quantitative methods at a national and strategic level to optimise many aspects of the war effort [20]. 'Soft Systems Methodology' was developed in the UK, pioneered by Peter Checkland (an INCOSE Pioneer) during the 1970s, to find better ways to design systems to serve human and organisational purposes. Derek Hitchins, the first president of the INCOSE UK and also an INCOSE Pioneer, has been hugely influential in shaping the thinking of the current generation of UK systems practitioners and is recognised internationally.

The UK Systems Engineering community continues to be influential internationally although probably not as much as during the more formative years of the discipline. Its perspective is perhaps leaner but more agile than certain other nations' approaches. There is also some departure from, and advance as compared with, international practice being evident (as is the case in the area of Safety Engineering).

Systems Engineers within the UK continue to apply the discipline across a broadening range of problems and to innovate in doing so. They draw upon much experiential practice, foundations in academia, and the comparatively limited UK research in this field. UK expertise in the field is acknowledged internationally.

Links into the UK Engineering Profession

Within the UK various engineering professional organisations are engaged with by IfSE, as is summarised below:

The Royal Academy of Engineering (RAEng): RAEng has the objective of pursuing, encouraging and maintaining excellence in the whole field of engineering to useful purpose in order to promote the advancement of the science, art and practice of engineering for the benefit of the public. It recognises the importance of Systems Engineering in delivering this objective and serves to orchestrate inputs from across engineering in pursuit of high-level and policy objectives. It also instigates action across engineering to promote action on issues such as STEM outreach, and diversity and inclusivity.

The National Engineering Policy Centre (NEPC): The NEPC is a partnership of 42 professional engineering organisations that cover the breadth and depth of the engineering profession, led by the RAEng. It marshals the nation's leading engineering expertise to provide practical policy advice on national and global challenges. It deploys engineering insights, promotes engineering and its role in policy, develops an inclusive and forward-looking partnership, and extends its expert network beyond engineering

[21]. Its views on principles for engineering knowledge, skills, and behaviours strike a chord with IfSE's, for example [22]:

> *'We understand and employ a 'systems approach' to easily navigate the relationship between the 'part' and the 'whole' and to align smaller, shorter-term goals with bigger, longer-term outcomes. We can apply both our creative and specialist technical skills to specific problems while understanding the impact of, and risks associated with their solutions at different scales and throughout their lifecycle.'*

As a further example, the NEPC has undertaken work to inform Government policy as it relates to the risks and benefits associated with autonomous systems across sectors and how they should be designed, developed and deployed to ensure benefits are widely distributed and no one is disadvantaged [23].

The Engineering Council: The Engineering Council is the UK regulatory body for the engineering profession. IfSE is licensed through the Engineering Council and participated in the update of the UK Standard for Professional Competence and Commitment (UK-SPEC) which was published in 2020 [13]. This standard recognises the fact that all engineers should have a core appreciation of broader, systems issues.

EngineeringUK: EngineeringUK (the working name of The Engineering and Technology Board) is a not-for-profit company whose purpose is to encourage a stronger, more representative workforce in which engineering and technology can thrive. It undertakes work to enable more young people from all backgrounds to be informed, inspired and progress into engineering and tech. Activities it undertakes include research, and outreach into schools and advocacy.

Historically IfSE (and more specifically INCOSE UK) has engaged with **The Science Council**. The purpose of The Science Council is to strengthen the collective impact of the science community for public benefit and it sets professional standards for scientists and science technicians. Such engagement will continue as many systems engineers are educated as physicists and Systems Science falls within its remit.

IfSE engages with each of these organisations, contributes to activities of relevance to Systems Engineering, and uses their outputs, 'offices' and networks to the benefit of Systems Engineering in the UK and the remit of IfSE.

Further organisations with whom engagement takes place on an 'as required' basis include:

- IfATE (Institute for Apprenticeships and Technical Education)/Skills England
- Transport Systems Catapult
- Aerospace Technology Institute
- Defence Growth Partnership
- Engineering and Physical Sciences Research Council (EPSRC)

Links with other Professional Engineering Institutions and Professional Bodies

Under the section on 'Systems Engineering and other Disciplines' several neighbouring managerial, (technology- and application domain-related) engineering and scientific disciplines have been identified together with some associated PEIs and other professional bodies.

Engagement with a number of PEIs and Professional Bodies has taken place over many years. Examples of such engagement includes:

- Collaborating with the IET on a variety of matters
- Working with the Institute of Explosive Engineers (IExpE) on professional registration
- Undertaking joint reports concerning Systems Engineering and Project Management with the APM
- Researching and documenting the architecting of safe systems with the SCSC
- Professional Engineering Committee (PEC)
- Early Career Engineers PEC
- EPC
- Royal Academy of Engineering
- Engineering Council
- Engineering UK

There are a considerable number of further professional bodies and organisations with interests relating to Systems Engineering. These include:

- Design Society
- Hazards Forum
- International Centre for Complex Project Management
- ITEA (International Test and Evaluation Association)
- NAFEMS (International Association of the Engineering Modelling, Analysis and Simulation)
- System Dynamics Society
- International Society for the Systems Sciences
- Built Environment Connective.
- Centre for Systems Studies (University of Hull)
- The Systems Society (UK Systems Society – Promoting Systems Thinking for the 21st century)

The landscape of PEIs and professional bodies in the UK is complex and would benefit from presenting in a coherent, systemic format. Given the level of resources IfSE has at its disposal it must prioritise its engagement on the basis of importance, opportunity and potential impact.

Links into International Systems Engineering

Despite its renaming IfSE remains the UK Chapter for INCOSE and through its Memorandum Of Association (MOA) this close relationship, with associated membership advantages, will continue.

This enables, for example, IfSE members to readily access INCOSE products such as the Systems Engineering Handbook, to participate in the certification scheme, and for national working groups to engage with and contribute to international working groups. Three INCOSE UK members have been elected as INCOSE President (Samantha Robitaille 2010-11, David Wright 2014-15, and Alan Harding 2016-17) indicating the standing which UK systems engineers have internationally.

This extends to participation in international standardisation activities, including but not restricted to ISO/IEC Joint Technical Committee (JTC) 1 Sub-Committee (SC) 7 which concerns Systems and Software Engineering. For example, Stuart Arnold edited the foundational ISO/IEC 15288:2003 standard. UK systems engineers continue to participate in SC7 standards, Object Management Group (OMG) specifications and standards, and The Open Group (TOG) standards and guides.

Further Information

IfSE provides a range of professional publications for Systems Engineering practitioners and other interested parties. For more information, such as: Z guides, Omega Guides, Posters, the INCOSE Systems Engineering Handbook, INCOSE Competencies Framework, Technical Books, Outreach publications, Conference Proceedings, Working Group outputs please visit us at: https://ifse.org.uk.

To keep up-to-date with current information:

Follow us on LinkedIn

Institute for Systems Engineering (IfSE)

Invitation to Participate

IfSE is committed to an inclusive approach working with a wide range of stakeholders to improve the appeal, practice and application of Systems Engineering in the UK.

We want this report to be inclusive and accurate. We apologise in advance for any omissions and errors. We invite all UK organisations with an interest in Systems Engineering and the systems approach to contribute towards improving the accuracy, completeness and utility of future versions. If you want to get in touch, for instance to offer help, provide details of your activities, how you apply Systems Engineering in your sector or organisation, what courses you run, etc. then please contact: outreach-director@ifse.org.uk.

Assessment

Systems Engineering is a discipline with a long heritage and with pioneering work (on an international scale) being undertaken in the UK. In developing into the recognised PEI for Systems Engineering in the UK, IfSE has engaged with a broad and increasing range of relevant organisations and institutions including the Royal Academy of Engineering, the National Engineering Policy Committee, the Engineering Council, EngineeringUK, and the Science Council. It also engages very widely with other organisations concerned with education, apprenticeships, growth etc.

Within the field of UK engineering (and related) professions, IfSE engages with many other Professional Engineering Institutions and professional bodies at both level of Council/Officer and also at the (working and interest) group levels. International engagement is largely through the international professional body, INCOSE, with IfSE remaining as the UK national chapter for this organisation. For IfSE members who chose to hold a joint membership with INCOSE this provides extensive access to international groups together with a range of products (such as publications) and services.

In the future IfSE will need to consider the extent of its engagement concerning engineering standards. Such standards constitute internationally recognised requirements and norms for conducting professional engineering practice. Key responsible organisations include the International Standards Organisation (ISO)/ International Electrotechnical Commission (IEC), The Open Group (TOG), and the Object Management Group (OMG). INCOSE increasingly participates in and even initiates standards development concerning Systems Engineering. IfSE will need to do likewise. The risks and costs of such participation will need careful consideration moving forwards. Presently relatively small numbers of UK individuals (including members of IfSE) participate in such initiatives largely on an individual basis or representing an employer. Some limited UK coordination is provided by organisations such as the UK national standards body, British Standards Institution (BSI).

Annexes

Annex 1 Systems Engineering Standards, Maturity Models and Professional Guidance

International standards

BS EN ISO 9001:2015+A1:2024, 'Quality Management Systems – Requirements', 2024, International Organisation for Standardisation

BS ISO/IEC/IEEE 15288:2023, 'Systems and Software Engineering – System life cycle processes', 2023, ISO/IEC

BS ISO/IEC/IEEE 15289:2019 'Systems and Software Engineering – Content of life-cycle information items (documentation)', 2019, ISO/IEC

BS ISO/IEC/IEEE 29148:2018 'Systems and Software Engineering – System life cycle processes – Requirements engineering', 2018, ISO/IEC

BS ISO/IEC/IEEE 42020:2019, 'Systems, Systems and Enterprise – Architecture processes', 2019, ISO/IEC

BS ISO/IEC/IEEE 24748 (various parts): various dates, 'Systems and Software Engineering – Life Cycle Management', various dates, ISO/IEC

BS ISO/IEC/IEEE 16085:2021, 'Systems and Software Engineering – System life cycle processes – Risk management', 2021, ISO/IEC

BS ISO/IEC/IEEE 21839:2019, 'Systems and Software Engineering – System life cycle processes – Systems of systems (SoS) considerations in life cycle stages of a system', 2019, ISO/IEC

Maturity Models

'Capability Maturity Model Integration (CMMI) for Systems Engineering/Software Engineering', Version 1.1, Staged Representation (CMMI-SE/SW, V1.1), 2001, Carnegie Mellon University

BS ISO/IEC 15504 (various parts): various dates, 'Information technology — Process assessment', various dates, ISO/IEC

Handbooks, Guides and Frameworks

'Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities', INCOSE-TP-2003–002-05, Version 5, 2023, INCOSE

'NASA Systems Engineering Handbook', Revision 2, January 2020, NASA www.nasa.gov/connect/ebooks/nasa-systems-engineering-handbook

'MITRE Systems Engineering Guide', 2014, MITRE https://www.mitre.org/sites/default/files/publications/se-guide-book-interactive.pdf

'NATO Architecture Framework', Version 4, 2018, NATO https://www.nato.int/cps/en/natohq/topics_157575.htm

'Unified Architecture Framework', Version 1.2, 2022, Object Management Group https://www.omg.org/spec/UAF

'Systems Engineering Competency Framework', INCOSE-TP-2018-002-01.0, 2018, INCOSE https://www.incose.org/publications/products/competency-framework

'Guide to the Systems Engineering Body of Knowledge (SEBoK)', Version 2.11, 2024, INCOSE/IEEE Systems Council/Stevens Institute of Technology https://sebokwiki.org/wiki/Guide_to_the_Systems_Engineering_Body_of_Knowledge_(SEBoK)

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[4] 'Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities', INCOSE-TP-2003–002-05, Version 5, 2023, INCOSE

[5] BS ISO/IEC/IEEE 24773-3:2021, Certification of software and Systems Engineering professionals – Part 3: Systems Engineering', 2023, ISO/IEC

[6] 'Comprehensive Human Appraisal for Originating Software (CHAOS) Report 2015', 2015, Standish Group

[7] 'Systems Engineering Competency Framework', INCOSE-TP-2018-002-01.0, 2018, INCOSE

[8] https://raeng.org.uk/policy-and-resources/support-for-policymakers/systems-workshops

[9] 'EngineeringX – Safer Complex Systems: An Initial Framework', 2021, RAEng

[10] 'Navigating the Skills Shortage: Annual Rail Workforce Survey 2024', 2024, National Skills Academy for Rail (NSAR)

[11] 'Nuclear Workforce Assessment', March 2025, Cogent Skills

[12] 'The UK's Modern Industrial Strategy', CP1337, June 2025, His Majesty's Stationery Office

[13] 'UK Standard for Professional Competence and Commitment' (UK-SPEC), Edition 4, 2020, Engineering Council

[14] 'INCOSE Annual Report 2024', 2025, INCOSE, accessible online at https://www.incose.org/docs/default-source/annual-reports/2024_incose_annualreport.pdf?sfvrsn=a7c651c7_3

[15] 'Engineering skills needs – now and into the future - A report produced by Lightcast for EngineeringUK', 2023, EngineeringUK, accessible online at https://www.engineeringuk.com/media/ge1bxifs/engineering-skills-needs-report-lightcast-engineeringuk-may-23.pdf

[16] 'Engineers 2030 – Final Report - The future of engineering education and skills',

RAEng / National Engineering Policy Centre, accessible online at https://nepc.raeng.org.uk/media/mpifpogd/nepc-engineers-2030-final-report-1.pdf
[17] Call to action to reverse small but worrying spike in women aged 35 to 44 leaving engineering, accessible online at https://www.engineeringuk.com/latest-news/press-releases/spike-in-women-aged-35-to-44-leaving-engineering/
[18] 'The Accreditation of Higher Education Programmes' (AHEP), Edition 4, 2020, Engineering Council
[19] '2020 SEASON Report', 2020, INCOSE UK
[20] https://www.engc.org.uk/media/3lqpvgwc/approval-and-accreditation-of-qualifications-and-apprenticeships-aaqa-standard.pdf
[21] https://ieee-aess.org/publication/ieee-open-journal-system-engineering
[22] Kirby, M. W., 'Operational Research In War And Peace: The British Experience From The 1930s To 1970', 2003, Imperial College Press
[23] 'National Engineering Policy Centre 2027 Strategy', 2022, NEPC
[24] 'Engineers 2030: Rethinking engineering and technology skills for a world in which both people and planet can thrive: Vision and principles – A consultation, 2024, NEPC
[25] 'The journey to an autonomous transport system: identifying challenges across multiple modes: Summary of a roundtable discussion', 2020, NEPC

Academic Links

Department and Groups

Cranfield University https://www.cranfield.ac.uk/courses/taught/systems-engineering

Loughborough University https://www.lboro.ac.uk/schools/meme/research-and-innovation/research-priorities/systems-engineering-at-loughborough/

University of Portsmouth https://www.port.ac.uk/study/courses/postgraduate-taught/msc-systems-engineering

University College London https://www.ucl.ac.uk/mathematical-physical-sciences/systems-engineering

University of Strathclyde https://www.strath.ac.uk/courses/postgraduatetaught/systemsengineeringmanagement/

University of Bradford https://www.bradford.ac.uk/courses/pg/satellite-systems-engineering/

University of Bolton https://greatermanchester.ac.uk/course/msc-systems-engineering-electronic-and-engineering-management-double-award-soest-full-time-18-months-university-of-bolton/2025-26

University of York https://www.york.ac.uk/study/postgraduate-taught/courses/msc-safety-critical-systems-engineering/

University of Leeds https://courses.leeds.ac.uk/f310/embedded-systems-engineering-msc-eng-

Coventry University https://www.coventry.ac.uk/course-structure/pg/ees/embedded-systems-engineering-msc/

University of Glasgow https://www.gla.ac.uk/postgraduate/taught/computer-systems-engineering-gadjah-mada/

University of Surrey https://www.surrey.ac.uk/school-sustainability-civil-and-environmental-engineering/research/centre-infrastructure-systems-engineering

University of Oxford https://eng.ox.ac.uk/systems-engineering

University of Bristol https://www.bristol.ac.uk/research/groups/systems-centre/

University of Nottingham https://www.findaphd.com/phds/university-of-nottingham/?41wk100&Show=M&Keywords=systems+engineering

University of Newcastle https://www.ncl.ac.uk/postgraduate/degrees/8090f-32/

Cambridge University https://www.gci.cam.ac.uk/subject/systems-engineering

University of Sheffield https://usic.sheffield.ac.uk/blog/why-study-systems-engineering

Cardiff University https://www.cardiff.ac.uk/research/explore/research-units/systems-and-scalability

University of Edinburgh https://eng.ed.ac.uk/research/institutes/ies

University of Bath https://www.bath.ac.uk/courses/undergraduate-2026/electronic-and-electrical-engineering/beng-computer-systems-engineering/

University of Warwick https://warwick.ac.uk/study/undergraduate/courses/beng-systems-engineering/

University of Southampton https://www.southampton.ac.uk/courses/space-systems-engineering-masters-msc

University of Liverpool https://www.liverpool.ac.uk/courses/energy-and-power-systems-msc-eng

Liverpool John Moores University https://www.ljmu.ac.uk/study/courses/undergraduates/2026/36183bgh-mechatronics-and-autonomous-systems-beng-hons

University of Birmingham https://www.birmingham.ac.uk/study/postgraduate/subjects/railway-engineering-courses/railway-systems-engineering-integration-msc

City St George's, University of London https://www.citystgeorges.ac.uk/prospective-students/courses/undergraduate/engineering-systems#content

Imperial College London https://www.imperial.ac.uk/systems-engineering-innovation/

Queen Mary University of London https://www.qmul.ac.uk/undergraduate/coursefinder/courses/2026/computer-systems-engineering/

University of Exeter https://www.exeter.ac.uk/study/undergraduate/courses/engineering/systems/

Annex 2 Employers of IfSE Membership

Note that membership data used in this report is from 25th of November 2025, so represents a contemporary snap-shot in time.

Organisations employing at least one member:	361

'Top 15' Employers of INCOSE Membership

The top 15 employers by individual membership are:

BAE Systems	119
Thales	90
AtkinsRéalis	73
AWE	39
WSP	38
Synoptix	37
Leonardo	36
QinetiQ	32
MBDA	27
BMT	25
Rolls-Royce	23
Sellafield Ltd	23
DE&S	22
Frazer-Nash Consultancy	22
Babcock	21
Total Number of Employees by 'Top 15' Organisations:	627
Percentage of IfSE Membership employed by 'top 15' organisations:	35%
Total Active Members on date of sample:	1775
Number who gave no allegiance:	439
Number who gave an allegiance:	1336
Membership Type (Active Members Only)	
Students	65
Affiliates	53
Professionals	1548
Registered	98

Of Which:		
Government	50	3%
Universities	22	1%
Other	1703	96%

All Employers of IfSE Membership

Acciona
Acmena
Acron Aviation
Admontem Ltd
AECOM
AEON Engineering Ltd.
Air & Space Warfare Centre
Air Sector
Airbus
AKER SOLUTIONS
Akkodis
Alfanar
ALL.SPACE
Allie Engineering Ltd
Alstom
Alten
AM Designed Solutions
Ambrad Consulting Ltd
Amentum
Ansys
Antifragile Systems Ltd
Anturas Consulting
Apache Independent Experts Limited
AQUILA Air Traffic Management Services
Arcadis
Arqit Ltd
Artelia
Arup
ASMPT SMT Weymouth Ltd
Assystem
AstrAero Engineering Limited
AtkinsRéalis
Atlas Elektronik UK
Autonomous Resistor Ltd
AVL Powertrain UK Ltd.
AWE
AXIAH
Babcock
BAE Systems
Baker Hughes
BalfourBeattyVinci
Barlow Consulting Ltd
Beca Ltd
Bechtel
Becton Dickinson
Bentley Motors Limited
Bentley Systems
Bilfinger
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BMT
Boeing Defence UK
BP
Burge Hughes Walsh Limited
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Capgemini
Caterpillar Peterlee
Cavendish Nuclear
Ceres Power
CH2M
Chess Dynamics
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Civil Aviation Authority
Cleave Systems Ltd.
CMTG
CNH Industrial
Colin Hood Systems Engineering Ltd
Collins Actuation Systems
Collins Aerospace
Commerce Decisions
Consultant Systems Architect
Corbil LTD
Costain
CPC Project Services
Cranfield Aerospace Solutions
Cranfield University
Cubic
Cummins Inc.
Curtis Instruments
Curtiss-Wright (Wimborne)
Customer Driven Solutions Limited
Customroute Ltd
d2e Consulting Ltd
Dashwood Systems Engineering
Dassault Systemes
DE&S
Decision Analysis Services Ltd
Deep
Defankle Innovation Limited
Defence Aviation Solutions
Deloitte
Delta Energy Systems
Dennis Eagle
Devonport Royal Dockyard Limited

Digital Railway
DNO
D-Orbit UK
Draeger Safety UK
DSTL
DT Assessment and Consultancy
Dunmail Systems Engineering
East Midlands Railway
East West Rail
Eaton Mission Systems Division
Eclectica Systems Ltd
Edinburgh Systems
Edwards Limited (Edwards Vacuum)
Elbit Systems UK
Embedkom Engineering Ltd
Energy Systems Catapult
Engineer for Safety Limited
Engineering Consultancy
Enoda Ltd
EUMETSAT
Eurostep
Eutelsat OneWeb
Eve Systems
Evolito Ltd
Expleo
EziLogic Limited
Farming Systems Ltd
Flagstaff Limited
Flextronics Romania SRL
Frazer-Nash Consultancy
Fujitsu UK
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GE Aviation
GE Vernova
General Dynamics Land Systems - UK
GHD
GJB Consulting
GKN Aerospace
Global Smart Transformation Ltd
Gordon Murray Automotive
Government Property Agency
Grasp Consulting Ltd
Haneng Ltd
Harmonic Limited
HENSOLDT Sensors GmbH
Hitachi
HK Systems Ltd
Holistem Ltd
Hong Kong Housing Society
HORIBA MIRA
HS2
Idealogix Ltd
Ideas Global Train Control Engineering Ltd
Imperial College London
Indra Sistemas
Infinity Systems Engineering Ltd
Innovation & Design Engineering Ltd
Integrate Systems Consulting Ltd
Intracom Defense
Inzpire Ltd
Itron, Inc
Jacobs
Jaguar Land Rover
JG Systems Consulting Ltd
JH Systems Ltd.
JLR
JP Parker Consulting
Katesby Process Engineering Limited
KBR
KISPE Space
Knight-Collyer
KONE Corporation
L-3 TRL Technology
L3Harris
Lancaster University
Laser Know How Limited
Leonardo
LGFR Ltd
LimitedUCL
Liverpool John Moores University
LLoyd's Register
Lockheed Martin
Logiq Consulting
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Loughborough University
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MBDA
Mclaren Automotive
McNeil Jordan Consultancy Limited
Meacher Systems
Mexim Limited
Michael Whittingham
Ministry of Defence - Other
MirvSys Ltd
Model Answer UK Ltd
Morson Group

Mott Macdonald
National Composites Centre
National Physical Laboratory
NATO Communications and Information Agency
NATS
NCC Group
NES Fircroft
Network Rail
New Frontier Systems Limited
New Murabba, PIF
Newcastle University
newcleo Generation UK Ltd.
Nexteer Automotive
Niftylift
Nikon
Nokia
Northrop Grumman
NPL
Nuclear Waste Services
Nurtured Revolution Ltd
Nuvia
Occam Group Limited
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OneSubsea
Operational Solutions Ltd
OptaSense
Optima Systems Consultancy
Optimise Engineering
Osler Diagnostics
Oxford Hypernautics Ltd
PA Consulting
Park Signalling Limited
Peanut Engineering Limited
Platform First Ltd
POLARIS Raumflugzeuge GmbH
Polestar
Portsmouth Aviation Ltd
Powertrax Ltd
Primetals Technologies
Project Performance International
PROTONIUM
PTC
QinetiQ
Quanta Dialysis Technologies
Quantaltytics
Queen Mary University of London
Quest Global
Raaein
Rail Safety and Standards Board
Raytheon UK
RB Systems
Realistic EA
Renishaw plc
Rhea Space Activity UK
Rhomberg Sersa
Ricardo UK
Risk Based Decisions Ltd
RLE-Futuremotiv
Roke Manor Research
Rolls-Royce
RQM+
RTX
SA Group Ltd
SAAB, Australia
Safran Electrical & Power
Samaru System Engineering Ltd
SAMI
Scarecrow Consultants
SCS
SDA (UK MOD)
SEA
Seastar Systems Ltd
Secured Performance
SEL Rail Systems
Sellafield Ltd
SEMASS Ltd
SEMP Ltd
Sener Australia
Sensata Technologies
ServiceKey
Shell
Shine Consulting Limited
Siemens Mobility Limited
Siep Global Consulting Ltd.
SII UK
Sirius Analysis
SKA Observatory
Skanska
Smart DCC
Smiths Detection
Sofintsys Ltd
Solid Solutions
Space Forge
Sperry Marine
STFC
Stryker
SubSea Craft Ltd
Subsea7
Summerland Engineering Limited

Sutherland Systems Engineering Enterprise Ltd
SVGC
Swasivious Systems Ltd
Symtech ltd
Synoptix
Syscovery Ltd
System Design and Strategy Ltd
System Engineering Group
Systems Engineering & Assessment Ltd
Systems Expertise Ltd
SYSTRA
TATA ELXSI
TechnipFMC
Technology Dynamics Ltd
Teledyne Qioptiq Ltd
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Turner & Townsend
Turntide
UCL
UK Atomic Energy Authority
UK Health Security Agency
UK Research and Innovation
UKAEA
UKBIC
Ultra
United Kingdom Atomic Energy Authority
University College London
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University of Birmingham
University of Bristol
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University of Strathclyde
UNSW
VCMP UK
Vector GB Ltd
Veolia Nuclear Solutions (UK)
Veolia Nuclear Solutions (UK) ltd
Verge Motorcycles
Verlume
Viasat
Visteon UK Ltd
VoCATE Ltd
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Women's Engineering Society
WSP
X-net Chambers
ZeroAvia
ZF Group
Zuidema Consult GmbH

Annex 3 IfSE UK Advisory Board

The current composition of the IfSE UK Advisory Board is as follows.

Organisation	Sector
Amentum	Professional Services
Anturas Consulting Ltd	Professional Services
AtkinsRéalis	Professional Services
AWE Nuclear Security Technologies	Nuclear
BAE Systems	Defence & Aerospace
BMT Limited	Defence & Aerospace
Boeing UK	Defence & Aerospace
Burge Hughes Walsh Limited	Training Vendor
Costain	Construction
Dassault Systèmes UK Ltd	Tools Vendor
DE&S	Defence & Aerospace
Frazer-Nash Consultancy	Professional Services
GE Aerospace	Defence & Aerospace
HORIBA MIRA Ltd	Automotive
Jacobs	Transport & Defence
Leonardo	Defence & Aerospace
Loughborough University	Academia
MBDA	Defence & Aerospace
MTC	Manufacturing
NetworkRail	Rail
Optima Systems Consultancy Ltd	Professional Services
QinetiQ	Defence & Aerospace
Raytheon UK	Defence & Aerospace
Systems Engineering & Assessment Ltd	Defence
Sellafield Ltd	Nuclear
SEMP Ltd	Professional Services
Synoptix Ltd	Professional Services
Systra	Professional Services
Thales	Defence & Aerospace
University College London	Academia
UK Atomic Energy Authority	Nuclear
University of Strathclyde	Academia
WSP UK Ltd	Professional Services

amentum

BAE SYSTEMS

BMT

BURGE HUGHES WALSH

EDINBURGH SYSTEMS

FRAZER-NASH CONSULTANCY
A KBR COMPANY

SCARECROW CONSULTANTS

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