



Annual Systems Engineering Conference

19th – 20th November 2019

The Royal Armouries Museum, Armouries Drive, Leeds

“Celebrating the Future of Systems Engineering”

ASEC is the UK's premier Systems Engineering event, attracting a wide range of industry professionals, international presenters and practitioners, providing a distinguished platform for networking, learning and sharing ideas. This year's two-day conference will encompass:

- Four renowned keynote speakers:
 - The INCOSE presidents: Garry Roedler, Kerry Lunney and Alan Harding
 - Professor Emma Sparks: Named one of the 2018 top 50 women in Engineering
- Technical presentations on contemporary Systems Engineering theory and practice
- Tutorials run by leading Systems Engineering practitioners
- Exhibition of Systems Engineering organisations presenting their products and services
- A Systems Research Showcase poster competition
- A drinks reception will take place in the museum's Oriental Gallery followed by the Conference Dinner

For the latest information visit our conference website: ASEC2019.org.uk

This brochure is proudly sponsored by

QINETIQ

Welcome to ASEC 2019

Kirsty Akroyd-Wallis

President of INCOSE UK

Welcome to ASEC 2019

This year's ASEC promises to be a truly memorable experience as we celebrate our Silver Jubilee and 10th ASEC. INCOSE UK's ASEC remains the UK's foremost Systems Engineering Conference. It is a prominent date in our diaries where we look forward to bringing together a wide range of Systems Engineering professionals from a variety of backgrounds and industries. As always ASEC aspires to contribute towards the professional development of those attending.



We believe it is important to look to the future during our Silver Jubilee year, as well as reflect on the advances that have been made in the last 25 years. Therefore, this year we will be celebrating the theme "The Future of Systems Engineering". Within this theme, we aim to explore the following sub-themes: Inspiring the Next Generation, Advancing the Practices, and Pushing the Boundaries.

We are delighted to welcome four remarkable keynote speakers to ASEC 2019. On Day One the President, President Elect and Immediate Past President of INCOSE will be presenting the M'Pherson lecture. On Day Two Professor Emma Sparks of Cranfield University, who was named one of the top fifty women in Engineering in 2018 will be presenting the Arnold Lecture.

We are thrilled to be holding ASEC 2019 at the Royal Armouries Museum in Leeds, where we will be taking full advantage of the museum's facilities with our pre-dinner drinks reception taking place in the Oriental Gallery.

Once again, the INCOSE UK Systems Summit will take place on day two of the conference – which this year will be open to all delegates on a first come first served basis. This year's summit will explore the subject: "How do we capitalise on what we have achieved in the last 25 years". The purpose of the summit is to gather thoughts and opinions on the chosen topic from a wide range of professionals within the Systems Engineering community. This session will be facilitated by Professor Jon Holt, the Technical Director of INCOSE UK.

On behalf of the INCOSE UK Council I would like to thank our sponsors for their generosity in sponsoring ASEC 2019 and our Presenters and Keynote Speakers for sharing their foresight and expertise.

I would also like to welcome and thank the ASEC 2019 delegates for attending and celebrating with us, at this extra special ASEC and for contributing to the on-going success of INCOSE UK. Here's to another 25 years of excellence!



Keynote Address

We have two excellent keynote addresses this year, brought to you by leaders in their fields. In this anniversary year, INCOSE UK continue to honour two of the pioneers of Systems Engineering, who we have sadly lost. In recognition of their contribution to the world of Systems Engineering the “M’Pherson Lecture” will take place on day one and the “Arnold Lecture” on day two.

M’Pherson Lecture

Presented in memory of Philip M’Pherson who was a practitioner, educator and intellectual leader in Systems Engineering for over 45 years and an early and inspirational member of the UK Chapter of INCOSE. At City University in London, he set up the Department of Systems Science in 1972 – probably the first “Systems Professor” in Europe. His knowledge, passion and tenacity led the department into a position of intellectual leadership in applying Systems Thinking.

This year the M’Pherson Lecture will be presented by three leading INCOSE figures:



Garry Roedler

INCOSE President

Garry Roedler is a Senior Fellow and the Engineering Outreach Program Manager for Lockheed Martin and the President of the International Council on Systems Engineering (INCOSE). He has over 33 years of Systems Engineering (SE) experience that spans the full life cycle and includes technical leadership roles in both programmes and business functions. He is also an INCOSE Fellow, holds Systems Engineering certification at the Expert Systems Engineering Professional (ESEP) level, and received the INCOSE Founders Award. Garry has held key leadership roles in several industry associations and standards development organisations, including editor of ISO/IEC/IEEE 15288, Systems Life Cycle Processes and several other standards; and key editor roles for the Systems Engineering Body of Knowledge (SEBoK) and the INCOSE Systems Engineering Handbook. This unique set of roles has enabled Garry to influence the technical co-evolution and consistency of these key Systems Engineering and System of Systems resources.



Kerry Lunney

INCOSE President-Elect

Kerry Lunney has extensive experience developing and delivering large system solutions, including design, software development, infrastructure implementation, hardware deployments, integration, sell-off, training and on-going support. She has worked in various industries including ICT, Gaming, Financial, Transport, Aerospace and Defence, in Australia, Asia and USA. The systems delivered include combat systems, mission systems, communication systems, road and rail ITs, flight simulators, security systems, vehicle electronic systems, gaming systems and ICT foundation systems. Kerry is Country Engineering Director and Chief Engineer in Thales Australia. In this role she provides technical leadership and governance on bids and projects, delivers technical training programmes, and participates on a number of Technical Boards and Communities of Thales. Recent roles include Chief Systems Engineer, Solutions Architect and Design Authority.



Kerry is a member of IEEE, a Fellow Member of Engineers Australia with the status of Engineering Executive and Chartered Professional Engineer, and holds the Expert Systems Engineering Professional (ESEP) qualification from INCOSE.

In addition to her “day job”, Kerry is the INCOSE President-Elect. She has also been a past-INCOSE Sector Director for Asia-Oceania, a past-National President of the Systems Engineering Society of Australia (SESA), the Australian Chapter of INCOSE, and has held various roles on conference and events committees and University programme advisory boards throughout her career.

Alan Harding

INCOSE Immediate-Past President

Alan Harding is the immediate past-President of INCOSE, and is a systems engineer with over thirty years’ experience. He is the Head of Information Systems Engineering with the BAE Systems - Air business in the UK, a Chartered Engineer, and a Fellow of the IET. Alan is also a past president of INCOSE UK.



Arnold Lecture

Presented in memory of Stuart Arnold who had a significant impact on the practice of Systems Engineering in the UK. His success was due to his almost endless patience, razor sharp intellect and naturally collaborative approach. Along with a small number of other UK systems engineers, Stuart was responsible for building the credibility of the UK's Systems Engineering community on the international stage. Now, when a UK voice speaks up in a technical committee, INCOSE meeting, or project review, we are benefiting from Stuart's influence.

This year The Arnold Lecture will be presented by a leader in the UK Systems Engineering Community, named one of the top 50 women in engineering in 2018:



Professor Emma Sparks

**Director of Programme Portfolio Delivery & Deputy Director Education
Head of Centre for Systems Engineering, Cranfield Defence and Security, Cranfield University**

Professor Emma Sparks is the Director of Programme Portfolio Delivery, Deputy Director of Education and Head of the centre for Systems Engineering at Cranfield University. Responsible for strategic direction and management of the taught course portfolio for Cranfield Defence and Security as well as delivery of the Systems Engineering portfolio across teaching, research and consultancy. Emma is a Systems Engineer specialising in human systems, Systems Thinking, enterprise architecture and Human Factors Integration. She has a doctorate and masters in Systems Engineering for Defence and a Post Graduate Certificate in Learning, Teaching and Assessment for Higher Education.



Before joining Cranfield University at Shrivenham, Emma worked for five years as a research scientist within the Defence Clothing and Textiles Agency and latterly as Technical Lead for future soldier systems at the Defence Science and Technology Laboratory. Emma is internationally published and has worked extensively with overseas organisations, most notably the Defence Science and Technology Laboratory in Adelaide. In more recent years Emma has helped pioneer the first Level 7 Systems Engineering Apprenticeship with the Defence Growth Partnership. This reflects her passion for innovation in teaching practice and her desire to broaden engagement and accessibility in STEM disciplines. She is a member of INCOSE and the IET and was named as one of the Top 50 women in Engineering in 2018.

The background of the advertisement features a stylized, glowing blue and purple network of nodes and lines, overlaid on a dark blue background. A central vertical element, possibly a ship or a structure, is highlighted with a golden glow.

We are looking for people to join our growing team of Systems Engineers who are interested in applying and developing their technical expertise, across a number of domains, both military and commercial.

QinetiQ is dedicated to defending sovereign capability, protecting lives and securing the vital interests of our customers. Our Systems Engineers are renowned for providing high quality, independent technical advice to a wide range of customers, in support of their major acquisition programmes, and for developing our own range of world-leading products.

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Programme at a Glance

Please note: Each morning there will be a plenary session in the Conference Theatre, with additional parallel elements starting in the second morning session (additional sessions are shown below and on the next page). The tutorial sessions are held either side of lunch. These are limited to a maximum of 30 delegates each and should be registered for at the time of booking.

Although INCOSE UK will make every effort to provide the programme as advertised, it may become necessary, for reasons beyond our control, to make changes to speakers and / or to the timing and content of the programme. INCOSE UK and Dot-The-Eye Ltd will not be liable for any costs incurred by delegates in relation to such changes.

Registration is open each day from 08:15am

Day 1: Tuesday 19th November			
08:50 – 09:00	Introduction to Day 1		
09:00 – 09:45	President's Address & INCOSE UK Highlights		
09:45 – 10:30	M'Pherson Lecture - INCOSE Presidents		
10:30 – 11:00	Coffee		
	Conference Theatre	Tutorial	Tutorial
11:00 – 12:30	Interface Management	Or "Applying the Viable System Model" - Part 1	Or "Building and Using Living Business Models to Support Enterprise Plans and Initiatives" - Part 1
12:30 – 13:30	Lunch		
13:30 – 15:00	Future of Systems Engineering Part 1	Or "Applying the Viable System Model" - Part 2	Or "Building and Using Living Business Models to Support Enterprise Plans and Initiatives" - Part 2
15:00 – 15:30	Tea		
15:30 – 16:15	Future of Systems Engineering Part 2		
16:15 – 17:00	Panel		
19:00 – 19:30	Pre-Dinner Reception - Oriental Gallery		
19:45 – 22:00	Conference Dinner		

Day 2: Wednesday 20th November			
08:30 – 09:00	INCOSE UK Annual General Meeting		
09:00 – 9:45	Arnold Lecture Professor Emma Sparks		
09:45 – 10:30	Beginning in Systems Engineering Part 1		
10:30 – 11:00	Coffee		
	Conference Theatre	Tutorial	Tutorial
11:00 – 12:30	Beginning in Systems Engineering Part 2	Or "A New Approach to Handling Organisational Complexity" - Part 1	Or "The Truth is Elsewhere: Handling Constraints in a SysML Model" - Part 1
12:30 – 13:30	Lunch		
13:30 – 15:00	Novel Applications Part 1	Or "A New Approach to Handling Organisational Complexity" - Part 2	Or "The Truth is Elsewhere: Handling Constraints in a SysML Model" - Part 2
15:00 – 15:30	Tea		
15:30 – 16:15	Novel Applications Part 2		
16:15 – 16:30	President's Closing Remarks		

Additional Programme Elements

See following pages for details of all presentations, tutorials, and workshops.

INCOSE UK groups are given the opportunity to bid for 45-minute sessions across the two days to conduct group business or engage with delegates who may not normally be able to attend their meetings.

Following on from previous events where we have had successful Professionalisation slots, this year we will be offering two separate sessions on day one. The SEP Surgery and Professional Registration Briefing (invitation only) give delegates the opportunity to explore all aspects of Professional Development with INCOSE UK.

On day two we will be holding our third annual Systems Summit – exploring key topics for Systems Engineering and the wider community. The theme this year is “How do we capitalise on what we have achieved in the last 25 years?” The output of the Summit is used to steer and inform our future strategy within INCOSE UK. The session has limited spaces available; spaces can be booked via the ASEC 2019 booking system. The session will be facilitated by Prof Jon Holt, the current Technical Director of INCOSE UK, and will use our published TeamStorming approach to run the workshop. The initial feedback from the Summit will be given to the delegates at ASEC 2019 and a report will be generated.

These additional elements will take place in parallel to the main conference, as indicated below.

Day 1: (19th November 2019) Additional Elements			
Time	Breakout	Breakout	Breakout
10:30 – 11:00	Coffee	Coffee	Coffee
11:00 – 12:30	SEP Surgery	Or Tutorial - “Applying the Viable System Model”- Part 1	Or Tutorial - “Building and Using Living Business Models to Support Enterprise Plans and Initiatives” – Part 1
12:30 – 13:30	Lunch	Lunch	Lunch
13:30 – 15:00	Professional Registration Briefing (Invitation Only)	Or Tutorial - “Applying the Viable System Model”- Part 2	Or Tutorial – “Building and Using Living Business Models to Support Enterprise Plans and Initiatives” – Part 2
15:00 – 15:30	Tea	Tea	Tea
15:30 – 16:15	North West Group	Or Automotive Group	Or Early Careers Forum
16:15 – 17:00	Return to the main programme in the conference theatre		

Day 2: (20th November 2019) Additional Elements			
Time	Breakout	Breakout	Breakout
10:30 – 11:00	Coffee	Coffee	Coffee
11:00 – 12:30	Systems Summit - Part 1 (limited spaces available)	Or Tutorial - “A New Approach to Handling Organisational Complexity” - Part 1	Or Tutorial - “The Truth is Elsewhere: Handling Constraints in a SysML Model” Part 1
12:30 – 13:30	Lunch	Lunch	Lunch
13:30 – 15:00	Systems Summit - Part 2 (limited spaces available)	Or Tutorial - “A New Approach to Handling Organisational Complexity” - Part 2	Or Tutorial- “The Truth is Elsewhere: Handling Constraints in a SysML Model” Part 2
15:00 – 15:30	Tea	Tea	Tea
15:30 – 16:15	Free space	Or Energy Systems Engineering Group	Or Group Chairs Session-closed session
16:15 – 16:30	Return to the main programme in the conference theatre		

A Guide to the Event Programme

Event Structure

Each day of the conference consists of the following elements:

Early Morning Session

The early morning session each day features a keynote address. On Tuesday this will be preceded by an address from the President of INCOSE UK, covering the highlights from the previous year. On Wednesday this will be preceded by the AGM and then followed by a technical presentation.

Late Morning Session and Early Afternoon Session

At this point, delegates have the option to choose between a set of parallel tracks:

The main conference theatre offers back to back sessions of four presentations each day, covering contemporary topics expected to be of general interest to the audience, with a break for lunch half way through.

There are two tutorials running each day in parallel to the main conference session, which need to be booked in advance when booking for the conference. Details of these tutorials can be found on pages 8 and 9. All tutorials will run from 11:00 until 15:00 with a break for lunch. Attendance at these tutorials will be strictly limited on a first-come-first-served basis via the event booking system.

Additional programme elements are detailed on page 6 of this brochure.

Late Afternoon

Late afternoon sessions are primarily based in the main conference theatre; however, the 15:30-16:15 session also offers the opportunity for delegates to attend 45-minute sessions run in parallel with the main plenary session.

Signposting

Each presentation has been characterised in two dimensions, indicating the content and target audience.

Accessibility: This indicates the level of knowledge required by the delegates to fully understand the paper and gain the maximum benefit from its content. There are three levels here: 'Beginner' which is aimed at people who are new to the topic and will typically hold the Awareness level of competence in this area; 'Practitioner' which is aimed at people who have performed some work in this area and are looking to increase their knowledge and who will typically hold the Supervised Practitioner or Practitioner level of competence; and 'Advanced' which is aimed at people with extensive experience, who are looking to hone their skills and knowledge in the area and who will typically hold the Expert level of competence.

Application: There are three levels here, which are: 'Research' aimed at new ideas that have been carried out as part of a research project; 'Case Study' that details examples of how Systems Engineering good practice has been applied on real projects, showing real results; and 'Good Practice', that details how mature Systems Engineering practices are being disseminated, deployed and adopted.

These are indicated on the following pages using a set of icons depicted below.

Accessibility:			
	Beginner	Practitioner	Advanced
			
Application:	Research	Case Study	Good Practice

So, for example, a presentation aimed at Practitioners and containing a Case Study, would have the following set of icons after the title:



We hope that this will assist delegates in choosing which elements of the event programme they will attend.

Tutorials/Workshops

Day 1: 11.00-12.30 & 13.30-15.00

Applying the Viable System Model

Pauline Roberts
(Pauline Roberts Systems Practitioner)



This session is designed to give people an understanding of Stafford Beer's viable system model and how it can be applied in practice. We will share an understanding of the sub-systems of the model, their functions, how they interact, how that looks in an organisation and what it looks like when they are not functioning well. This will be achieved by applying the viable system model to a case study example, from the public sector, with the purpose of carrying out a basic diagnosis on the situation and coming up with a range of potential options for improvements. The tutorial will incorporate a combination of presentation and interactive discussion/group work and will be supported by a series of 'guides' that the presenter will use to help people navigate the diagnosis. As participants work through the case study, the presenter will share insights that were gained as she worked on the case study in the real world – the challenges, the opportunities, the stumbling blocks and what it was that made the viable system model work for her at the time.

Building and Using Living Business Models to Support Enterprise Plans and Initiatives

Kim Warren (Strategy Dynamics Ltd)



The Government's Blackett Review of UK computational modelling encouraged leaders to use models to support important decisions and to help build the required expertise. Systems Engineers have of course been doing exactly this for decades for technical projects and operations but are increasingly pushing the boundaries to assist with organisational management challenges. This workshop will explain a highly accessible process for building working, quantified simulations of any organisational plan or initiative. (The content will reflect classes recently added to the G.E. Systems Engineering Masters programme at Warwick University). This capability opens the door for Systems Engineering professionals to contribute more widely and effectively to the strategies and decisions of the organisations they work for, whether internally or as external consultants.

This tutorial will explain exactly what Living Business Models are and the types of challenges and plans for which they are ideally suited. You will see how simple, universal principles translate into a practical, agile process for building working simulations with problem owners fast. And you will get to try it yourself – building an example model in small groups. We will also discuss how to win user buy-in and understanding.



Day 2: 11.00-12.30 & 13.30-15.00

A New Approach to Handling Organisational Complexity

Dean Beale (University of Bristol)
Jeremy Hilton (Cranfield University)
Lorraine Dodd (Cranfield University)



Recognising that vast swathes of the world are increasingly complex, as opposed to complicated, is to accept that we need to change our approach to everything. The International Centre for Complex Project Management noted that the misunderstanding of the difference between ‘complicated’ and ‘complex’ projects is a major cause of difficulty and failure [Project Complexity Assessment, Cavanagh]. With complexity, defined as uncertainty between cause and effect [What do we mean by system, INCOSE Fellows], set to increase exponentially, the need for the whole organisation to engage with complexity effectively becomes desperately challenging. Many academic works and consultancies propose methods for engaging with complexity based on their own or others’ experiences and insights. However, as all experiences are different, especially in a complex world, and no community can experience everything, the suitability to your organisation beyond the sales pitch might be poor, or worse, unknown.

The purpose of this workshop is to take a fresh approach. To empower you with the insights, tools, techniques and a lexicon, to help you develop a holistic organisational way forward based on your unique culture and challenges.

This tutorial will lay the foundations for an exploration of complexity in your organisation. It will demonstrate how key techniques for handling complexity: assessing, mitigating and tailored improvement, can be created. It will provide generic working examples for all of these tools, that can be used and adapted according to your organisational needs, using the insights from the tutorial.

The Truth is Elsewhere: Handling Constraints in a SysML Model

Dr Aurelijus Morkevicius (No Magic Europe)
James Towers (No Magic Europe)





Most MBSE focuses on three of the four pillars of SysML: Requirements, Structure and Behaviour. There are many papers, books, and tutorials on how to handle one or more of these, but there are almost none focusing on the additional, and value added fourth pillar of Parametric Constraints. Capturing constraints in the model is necessary and is common practice in a document-centric Systems Engineering approach, but do we really know how powerful they can be in terms of verification, validation and simulation of models? Most likely we don’t. Furthermore, constraints aren’t just for parametric equations. By using constraint languages, within the Structural Views it’s possible to build a model with greater precision and with a high level of automatic verification than simply using SysML structural elements and relationships alone.

This tutorial focuses on the system constraints, their types, their application techniques, and the many different use cases that they address. Starting with the object constraint language (OCL) and finishing with the SysML constraint block, the main goal is to introduce participants to this mysterious part of MBSE and SysML.

The tutorial will feature a short lecture, practical assignments and a case study as a part of a real-world system model captured within a widely known MBSE tool.


Day 1: Morning Sessions - Presentation Abstracts

AM Session – Interface Management	
<p>11:00 11:45</p>	<p>Interface Management – the Neglected Orphan of Systems Engineering Paul Davies (thesystemsengineer.uk)</p>  <p>Every Interface is an opportunity to lose information, time, control and / or money through contention between stakeholders at either end. There are many issues surrounding Interface management, which are relatively unexplored in the engineering literature. Interface management is perceived as a critical skill in the engineering of successful systems, but finding useful material on the subject proves elusive. It is not that there is a gap in the collective Body of Knowledge (BoK) – but there is definitely a gap in the documented BoK. This paper explores some of the characteristics of this gap, and strings together some of the key concepts in best practice. Along the way, the differences between best practice for interfaces and best perceived practice for architecting systems are noted, and recommendations for changes in approach are given.</p>
<p>11:45 12:30</p>	<p>Interface Management, is it the Responsibility of Systems Engineers or Project Managers in Multi-disciplinary Rail Infrastructure Projects? Dr Hadi Sanei and Professor Alan Smith, University College London, UK</p>  <p>Who should be responsible for Interface Management in multi-disciplinary rail infrastructure projects? - project managers, systems engineers, both or neither. This work explores this issue through a survey of professionals and a weighted numerical model of the results. While there is no complete consensus it is somewhat alarming to find a significant population of professionals ‘on the fence’.</p>


Best Paper by a New Author and Presenter

The Charterhouse Award

We are pleased to announce that Charterhouse Systems Limited will be sponsoring a new award at ASEC 2019: “Best Paper by a New Author and Presenter”. Presenting authors who have not written or presented at a previous INCOSE or INCOSE UK conference will be in with a chance of winning a £200 prize.



The prize, donated by Charterhouse Systems Limited will be awarded on Tuesday 19th November after the event dinner.


Charterhouse Systems Limited

Day 1: Afternoon Sessions - Presentation Abstracts

PM – Session. Future of Systems Engineering Part 1

<p>13:30 14:15</p>	<p>Horizon scanning to discover the future of Systems Engineering Duncan Kemp, UK MOD and Dawn Gilbert, UK MOD</p> <p> </p> <p>This paper describes the Systems Engineering Horizon Scanning activity carried out by the MOD's Systems Engineering Internal Technical Support Team from September 2017 to March 2019. The work was initiated to improve the rigour of Systems Engineering Horizon Scanning to better inform the development of SE strategy and policy within Defence Acquisition.</p> <p>The intent was to understand the evolving nature of Systems Engineering across multiple sectors across the globe. This paper covers the second year of horizon scanning, which has built upon the first year and shown some initial benefits in day to day delivery of SE within DE&S. The approach used was developed by tailoring methodological advice and guidance from UK Government departments and from the 35-nation member Organisation for Economic Co-operation and Development.</p>
<p>14:15 15:00</p>	<p>The opportunities and challenges of Systems Engineering in Undergraduate Programmes Dr Claire Lucas, University of Warwick and Dr Thomas Popham, University of Warwick</p> <p> </p> <p>The University of Warwick runs a Systems Engineering undergraduate degree, which is one of only a handful in the UK. Professional systems engineers typically have a background in a specific discipline and have learned Systems Engineering through professional or post-graduate study.</p> <p>In the past 4 years, the School of Engineering hired two specialists from industry (Dr Claire Lucas, Mathematical Modelling and Dr Thomas Popham, Technical Specialist Machine Intelligence) to design, manage and deliver the undergraduate teaching of Systems and Information Engineering. We describe our approach to this redesign from the identification of high-level needs down to the learning and teaching methods at module level. We also discuss some of the challenges that are facing System Engineering at an undergraduate level including: shortage of academic experience in Systems Engineering, the low profile of Systems Engineering as a career and the difficulties in transitioning students from solving well-defined textbook problems to solving open-ended system problems.</p>

Day 1: Afternoon Sessions - Presentation Abstracts

PM – Session. Future of Systems Engineering Part 2

Creating the Next Leaders in Systems Engineering Malcolm Thomas WSP UK Ltd and Steven Turner WSP UK Ltd



The WSP Systems Engineering and Integration team is committed to attracting the best talent and developing them into world class systems engineers. However, as a company we face two challenges to achieving this objective:

15:30
16:15

1. There continues to be a small pool of recognised and experienced System Engineers and they tend to be highly clustered in a few locations not always coincident with our offices or projects.
2. There are very few universities who have a 'pure' System Engineering course or include System Engineering as a taught module, and this restricts the number of new entrants to the discipline with any form of education or experience.

WSP has implemented a holistic approach to identifying talent and the recruitment, training and development of our system engineers. This paper will describe the processes we have put in place to develop our team members to achieve their goals and become great systems engineers and how these processes have driven our business performance. It will also highlight the STEM engagement activities we have undertaken to promote System Engineering as a discipline and inspire the next generation.

16:15
17:00

Panel



Best Overall Paper and Systems Research Showcase Poster Competition

We are pleased to announce that Dyson are sponsoring both the Best Overall Paper and Systems Research Showcase Poster Competition.

Delegates will have the opportunity to read the posters and discuss the research findings with the poster authors during the event.

Prize donated by



The Best Overall Paper and the Best Poster will be announced after the event dinner on Tuesday 19th November 2019.

INCOSE UK ARE ENTERING ALL DELEGATES WHO BRING THEIR OWN BAG INTO A PRIZE DRAW ON DAY TWO OF THE CONFERENCE.



Day 2: Presentation Abstracts

AM – Sessions – Beginning in Systems Engineering Part 1

The Open Source Satellite Programme: using Systems Thinking and MBSE to align the team and explore the problem
Vicky Anderson, KISPE Space



The goal of the Open Source Satellite Programme is to stimulate the responsible and sustainable use and exploration of space. This will be achieved through the development of an accessible, highly capable, cost-effective, modular microsatellite platform. Through taking an open source approach, our intention is to achieve a price performance point that truly makes space more affordable.

09:45
10:30





It isn't often engineers are given an opportunity to start with a truly clean sheet of paper and a remit to actively challenge the mindset of "but it has always been done this way". However, with the development of the Open Source Satellite this is exactly where it is starting from. This makes it an exciting prospect, but this excitement is tempered by the awareness that care needs to be taken to ensure the development doesn't become constrained by the mental models moulded from the team's experience.

This paper examines the Systems Thinking and MBSE approaches that are being taken by the Open Source Satellite Programme team through the early development stages to explore the problem space and the concerns of the associated stakeholders.



Day 2: Presentation Abstracts

AM – Sessions – Beginning in Systems Engineering Part 2

<p>11:00 11:45</p>	<p>Better Asset Information Management Dave Burton, Frazer-Nash Consultancy and Daniel Wilson, Electricity North West</p> <p> </p> <p>Organisations involved in the management of assets, such as electrical distribution network operators (DNOs) rely on asset information to enable effective decision making. DNOs power the lives of millions of people through thousands of kilometres of cable and associated electrical assets. However, despite the complexity of these networks, and the potential for emergent behaviour, Systems Engineering techniques are not widely used within the electrical distribution industry.</p> <p>In this paper, we will explain how Systems Engineering techniques were combined with an understanding of Asset Management to explore the asset information requirements of an electricity DNO. In particular, we will describe how holding workshops with a variety of stakeholders and use of a structured model enabled understanding of the information needed, when and where it is needed, by whom, and how often.</p>
<p>11:45 12:30</p>	<p>Are you Understanding or Managing your Requirements? Rob Behan, Scarecrow Consultants Ltd</p> <p> </p> <p>Requirements have been used by engineers for many years. Until the availability of modern IT office software, the requirements would have been captured and referred to in a purely document based environment. The onset of modern computing with the availability of MS Excel and Word, allowed engineers to investigate the possibility of using spreadsheet and 'electronic document' methods of capturing their requirements. This capability was then added to with the introduction of specialist requirements management tools such as the IBM Rational DOORS software.</p> <p>With the availability of Systems Modelling Languages such as UML and SysML (from the late 1990s) and associated modelling software, engineers now, not only have a much more robust way of capturing requirements, but also a more thorough way to understand these requirements and their application to the system of concern. This paper will investigate how the use of SysML modelling takes the engineer from the basic management of requirements to one where they can gain a greater understanding of requirements and their generation, applicable to a practical example.</p>

Day 2: Afternoon Sessions - Presentation Abstracts

PM – Session – Novel Applications Part 1

A decision- tree for modelling approaches to use a digital twin in analysing systems interdependencies in infrastructure projects

Long Chen, Filip Babovic, Jennifer Whyte - Centre for Systems Engineering and Innovation, Imperial College London. Carl Gamble, John Fitzgerald, Ken Pierce - School of Computing, Newcastle University. Cristian Genes, Giuliano Punzo - Department of Automatic Control and Systems Engineering, University of Sheffield



**13:30
14:15**

Engineers and managers on infrastructure projects are increasingly able to access and generate large volumes of data. How can they prioritise modelling methods to get best insight from the data available? What can they do to collect and structure data appropriately to address the technical questions that arise? This paper describes a decision-tree for project engineers and managers considering the use of asset information modelling, multi-modelling and network theory to address interdependencies that arise in 1) late design and 2) operation. It is based on research to demonstrate the feasibility of using the data contained within a digital twin to generate new insights on systems interdependencies. The purpose of the decision-tree is to suggest the applicability of different forms of modelling approaches in different phases to address different questions and scenarios. It identifies the types of information required for such modelling, where projects involve heterogeneous data, that may encompass, geometric and time-series data. For example, in operation, or in preparing for operation, network theory may be useful for the day-to-day modelling of dynamic operations, but multi-modelling may provide more fidelity for designed interventions, including maintenance. The paper identifies directions for future research and makes recommendations for researchers and practitioners working on systems interdependence, modelling and the digital twin.

Doing Things Differently in Support

Ian Gibson, Atkins



**14:15
15:00**

This paper highlights some of the findings from a recent task which has developed a multi-year programme of work to transform the delivery of “Engineering Support” within UK Ministry of Defence (MOD) and will identify some techniques which may have wider applications.

The task itself was relatively straightforward in conception. Test and refine the MOD vision paper for “Engineering Support Transformation” (EST) through stakeholder workshops and technology surveys in order to develop a programme of work to deliver the transformation. In practice, there were a few more twists and turns along the way, necessitating the development of target architectures and thematic perspectives to accommodate the various stakeholders.

From the very outset of the task we had a 3-level model of change in mind: “Do things better”, “Do things differently” and “Do different things”. This provided a much-needed challenge function to ensure that we looked beyond the obvious and considered changes that would be truly transformational. We also used a novel approach based upon system dynamics influence diagrams to try to relate the performance improvements quoted in case studies to the types of benefits that the programme office wanted to see.

A key element will be ensuring that Engineering Support governance is properly defined within the wider evolving Defence Support Operating Model (DSOM), as this is needed as a key enabler for many of the interventions and innovations to be progressed.

Day 2: Afternoon Sessions - Presentation Abstracts

PM – Session – Novel Applications Part 2

What's in a Name?

Simon Perry, Scarecrow Consultants Ltd and Stephen Powley, Institute for Future Transport and Cities.



Architectures are an important part of Systems Engineering and should be based on architecture frameworks (AFs). Techniques exist to help organisations create robust AFs, such as the Framework for Architecture Frameworks (FAF), which is based on agreeing a set of defined terms (Ontology Elements) and the relationships between them (Ontology Relationships), collecting these together in an Ontology.

15:30
16:15

However, even when using such techniques, two main problems arise: terms with different names but the same meaning, and terms with the same name but different meanings. A number of changes and additions to the FAF are discussed that address the above naming problems. These changes force the distinction between Ontology Elements and Relationships that are common across all those working in a particular domain (an industry, field of research etc.), creating a Domain Ontology, and those Ontology Elements and Relationships used in a particular context (organisation, project, team etc.), creating a Context Ontology. The changes also ensure that these domain Ontology Elements and Relationships and context Ontology Elements and Relationships are mapped to each other. Examples are given of how these changes and additions are used.

Areas for further research are also discussed. These include: complex mappings between Ontology Elements and Relationships; the need for a "conflicts with" relationship as part of the solution for complex mappings; coverage metrics that measure how much of a Domain Ontology is covered by a Context Ontology and how much of a Context Ontology is the same as a Domain Ontology.

16.15 President's Closing Remarks



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Monday 18th November

7.00pm Start

Teams of up to 6. Information to follow

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A drinks reception is taking place in the museum's Oriental Gallery





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