

INCOSE UK
ASEC
2014



International Council on Systems Engineering (INCOSE) UK

Annual Systems Engineering Conference

18th – 19th November 2014

Royal Air Force Museum Cosford, Shifnal, Shropshire TF11 8UP



“Systems Engineering Then and Now -
Celebrating 20 years of INCOSE UK”

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ASEC 2014 - Our 20th Anniversary Conference



This year marks the 20th anniversary of the formation of INCOSE UK and I look forward to welcoming you to our Annual Systems Engineering Conference. The two-day event promises to be bigger and better than ever bringing together, as it does, world-class presenters and practitioners to highlight and celebrate how Systems Engineering has added value to the wider enterprise in the past, and how it will influence the future.

ASEC 2014 remains the UK's premier Systems Engineering event and provides an excellent forum for networking and sharing experiences. This year's conference will feature:

- Keynote addresses given by an eminent speaker on each day:
 - Day 1: Derek Hitchins, Inaugural President of INCOSE UK.
 - Day 1: Michelle Richmond, CEng FIET Director of Membership and Professional Development, The IET.
 - Day 2: David Long, President of INCOSE (International).
- Technical presentations on contemporary Systems Engineering theory and practice
- Tutorials run by leading Systems Engineering practitioners.
- An academic research showcase poster competition.
- The Conference Dinner, followed by an inspirational engineering story given by Dr Robert Fleming, Chief Executive of the Vulcan to the Sky Trust.

The venue for the event is the RAF Museum at Cosford. As well as a world-class collection, the museum also majors on research and development – with a number of unique examples of British engineering innovation such as one of the two TSR-2 prototypes, precursors to Concorde such as the Fairey Delta 2, and the recently arrived Experimental Aircraft Prototype.

Our conference will be held in the purpose-built facilities housing Cosford's National Cold War Exhibition. There will be time for delegates to view the exhibits prior to the Conference Dinner.

Please join us at ASEC 2014 whether you are an experienced Systems Engineering practitioner, new to Systems Engineering or want to find out if Systems Engineering is relevant to you.

I hope I will be able to meet as many of you as possible and I hope that we all have an informative, interesting and enjoyable time.

Alan Harding, BSc (Hons) CEng FIET - President of INCOSE UK

Derek Hitchins, Inaugural President of the INCOSE UK Chapter



Regarded by many as the 'grand statesman' of Systems Engineering in Europe, Derek began his career as an apprentice at Cranwell retiring 22 years later from the RAF as a Wing Commander. His move into the world of industry working as the System Design Manager of the Tornado ADV and Technical Director for UKAIR CCIS allowed him to continue to work in his specialist field.

He subsequently held posts in two leading Systems Engineering companies as Marketing Director, Business Development Director and Technical Director. He also worked as UK Technical Director for the NATO Air Command and Control Systems (ACCS) project in Brussels before becoming a full time academic, holding the Chair of Engineering Management at City University London.

From 1990 to 1994 he held the British Aerospace Chairs in Systems Science and in Command and Control at Cranfield University, RMCS Shrivenham. It was in 1994 that he was instrumental in founding INCOSE UK and became its inaugural president. In the same year he retired from the world of academia on medical grounds but continued working as a part time consultant, teacher, visiting professor and international lecturer.

His contribution to Systems Engineering was recognised by INCOSE Central in 1998 when they awarded him 'Pioneer' status. The citation read 'A proud public advocate and practitioner of Systems Engineering in Europe, and the spearhead and founding President of the United Kingdom Chapter of INCOSE. He has also published extensively in textbooks and journals, and has been an esteemed lecturer and professor throughout the United Kingdom and Europe.' He was the first European to receive this award and is now an INCOSE Fellow. He is the UK Charter Member of the Omega-Alpha Association – the International Honor Society for Systems Engineering.

He has written a number of books including Draft Guide to the Practice of System Engineering; Putting Systems to Work; Advanced Systems Thinking, Engineering and Management and an e-book Getting to grips with Complexity which develops an alternative to the Second Law of Thermodynamics for Open Systems.

After 20 years of research, he developed what appears to be the first complete Systems Methodology - the "how" of Systems Engineering which has been the Holy Grail of Systems Engineering for half a century or more. This resulted in the publication in 2007 of Systems Engineering: A 21st Century Systems Methodology, published by John Wiley and Sons in their Systems Engineering and Management Series. At present he is working on his latest book, "Human Systems;" so watch this space...

David Long, President of INCOSE (International)

A committed member of the worldwide systems community, David Long is the 2014/2015 President of INCOSE. David has served INCOSE since 1997 including a term as the Washington Metropolitan Area Chapter President and international roles including Member Board Chair, Director for Communications, and Director for Strategy. He is a frequent presenter at industry events worldwide delivering keynotes and tutorials spanning introductory Systems Engineering, the advanced application of Model-Based Systems Engineering (MBSE), and the future of Systems Engineering. In 2006, David received the prestigious INCOSE Founders Award in recognition of his many contributions to the organisation.

For over twenty years, David has focused on enabling, applying, and advancing MBSE to help transform the state of the Systems Engineering practice. David is the founder and president of Vitech Corporation where he developed and commercialised CORE®, a leading Systems Engineering software environment used around the world. Throughout his career, David has played a key technical and management role in refining and extending Systems Engineering to expand the analysis and communication tool kit available to Systems Practitioners. His experiences and efforts led him to co-author the book 'A Primer for Model-Based Systems Engineering' to help spread the fundamental concepts of this key approach to modern challenges. He continues to lead the Vitech team as they deliver innovative, industry-leading solutions to help organisations develop and deploy next-generation systems.

David holds a bachelor's degree in Engineering Science and Mechanics, as well as a master's degree in Systems Engineering from Virginia Tech.



After-Dinner Speaker: Dr Robert Pleming FRAeS MIET MBCS, Chief Executive, Vulcan to the Sky

As a young cadet Robert Pleming was awarded a RAF Flying Scholarship and so began a lifelong interest in aviation. However, after gaining a Doctorate in Nuclear Physics at Oxford University in 1977 his career took a different direction when he moved into IT. Moving through Systems Engineering and management roles in IBM, he became the Technical Director for Cisco Systems UK.

Twenty years later aviation was back in his life when Robert agreed with the then owner of the last Vulcan to fly, Avro Vulcan XH558, that a feasibility study should be carried out into the possibility of getting the plane back in the air.

Robert and a small team working in the evenings and at weekends, established sufficient credibility with the Vulcan's Design Authority, BAE Systems, for the decision to be taken to proceed with the return to flight.

In 2000, Robert moved from Cisco to become full-time director for the Vulcan Project, which succeeded spectacularly on 18th October 2007, with the test flight of the restored Vulcan, fourteen years after its last flight.

Since then, Robert has led the team that keeps XH558 flying. She has appeared in front of audiences totalling over 12 million around the UK, and has relied on the donations from an enthusiastic public for much of her £2.2million annual costs.



The Academic Research Showcase Poster Competition

This is a poster competition for academic research but unlike other competitions, it has a far wider remit. Contributions can come from individuals, full-time students or part-time graduate students, or from academic research groups at specific universities. Project contributions are also welcomed especially if they show collaborative work between partners on a single research project.

This year the response has been excellent and there will be ten separate posters on display at the event. The poster authors will be in attendance thanks to a complimentary registration and so delegates will have the opportunity to read the posters and discuss the research findings with the authors throughout the event.

A Guide to the Event Programme

Morning Sessions

Each day starts with a Keynote Speaker, followed by a selected presentation in the main conference theatre, with a coffee break half way through to allow delegates to explore the exhibition area and poster competition.

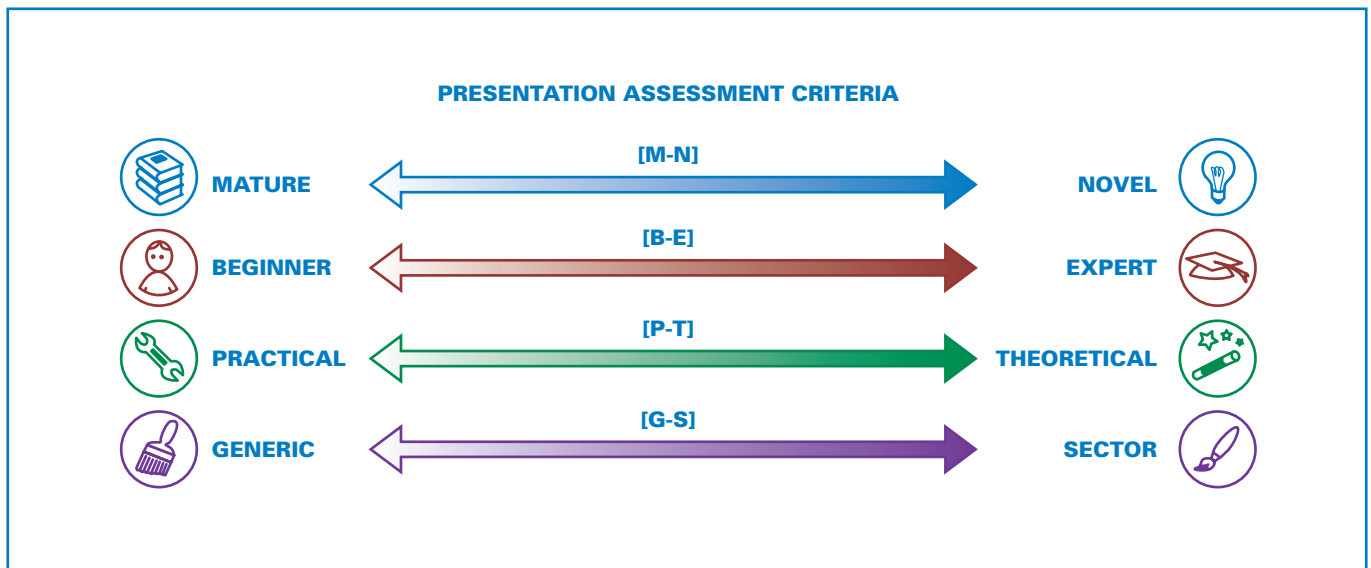
Afternoon Sessions

The afternoon sessions offer the opportunity for delegates to choose between different tracks within the conference:

- The main conference theatre offers back to back sessions of two presentations each, covering contemporary topics expected to be of general interest to the audience, with a tea break 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 page 6. Attendance at these tutorials will be limited to a maximum of thirty delegates and places will be awarded on a first-come first-served basis when booking.

Signposting

This year, each presentation has been characterised in four dimensions, indicating the content and target audience. These are indicated on the following pages using a set of icons depicted below.



So for example, a presentation containing Novel Ideas, aimed at Beginners, covering Practical ideas in a Sector specific context 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.

Note: in some cases, the authors have indicated that their presentations are aimed at both beginners and experts, so both icons appear side by side in the brochure.

Programme at a glance

Please note: each morning there will be a plenary session in the Conference Theatre.

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 will not be liable for any costs incurred by delegates in relation to such changes.

Registration is open each day from 08:00.

Day 1: Tuesday, 18th November - Morning

08:50 - 09:00	Introduction to Day 1
09:00 - 09:30	Keynote Speaker: Derek Hitchins, Inaugural President of the INCOSE UK Chapter
09:30 - 10:05	President's address and Working Group updates
10:05 - 10:20	"Engineering Professionalism", Michelle Richmond, Director of Membership and Professional Development, The IET
10:20 - 10:50	Coffee
10:50 - 12:10	"Applying Systems Engineering to Enterprises"
12:10 - 13:10	Lunch

Day 1: Tuesday, 18th November - Afternoon

	Conference Theatre		Tutorial		Tutorial
13:10 - 14:30	"Delivering Capability in the Transport Domain"	OR	"Gripping the STEM - Promoting Systems Engineering to the Wider Community" <i>Prof Jon Holt, (INCOSE UK Technical Director)</i>	OR	"Robust Design and Design of Experiments" <i>Dr Stuart Burge (Burge Hughes Walsh Partnership)</i>
14:30 - 15:00	Coffee				
15:00 - 16:30	"Interfaces and Agility"				
16:30 - 17:00	INCOSE UK Annual General Meeting				
17:00 - 19:30	Coaches to and from Conference Hotels in Telford				
19:30	Conference Dinner - Guest speaker: Dr. Robert Pleming, Chief Executive, Vulcan to the Sky				

Day 2: Wednesday, 19th November - Morning

08:50 - 09:00	Introduction to Day 2
09:00 - 09:40	Keynote Speaker: David Long, President INCOSE (International)
09:40 - 10:20	The Future of Systems Engineering: "The Next 20 Years - Systems Engineering in an Increasing Uncertain Environment"
10:20 - 10:50	Coffee
10:50 - 12:10	"Model-Based Systems Engineering"
12:10 - 13:10	Lunch

Day 2: Wednesday, 19th November - Afternoon

	Conference Theatre		Tutorial		Tutorial
13:10 - 14:00	"Metrics and Management"	OR	"Just What is MBSE?" <i>Simon Perry (Atego), James Towers (ObjectFlow)</i>	OR	"Communication Skills for Systems Engineers" <i>Ivan MacTaggart (Dstl), Kirsty Akroyd-Wallis (MBDA)</i>
14:00 - 14:30	Coffee				
15:00 - 16:20	"Human Factors and Systems Engineering"				
16:20 - 16:30	President's Closing Remarks				

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

Day 1 : Morning Sessions - Presentation Abstracts

AM - Session 1.2: "Applying Systems Engineering to Enterprises"

10:50 - 11:30

Enterprise Systems Engineering (ESE) & Systems of Systems (SoS)*Peter Brook, (Dashwood Consulting)*

The subjects of Enterprise Systems Engineering (ESE) and Systems of Systems Engineering (SOSE) have grown up separately and are now the subject of fast-growing literature, each for example featuring in the latest version of the Systems Engineering Body of Knowledge (SEBoK).

In simple terms, Enterprises are combinations of resources that work together to fulfil a common purpose, and Systems of Systems are groups of systems that may have separate goals but are capable of operating together when required. Both are recognised as the context in which many of the advances in System Engineering will be shaped, with the MOD's SOSA programme as a clear current example.

Because of this increasing significance, the ESE Interest Group has been exploring the overlaps and differences, through workshops and group discussions, supported by review of published material. It has found a number of common features which include:

- Concern with both social and technical dimensions and the interactions between them.
- Recognition of the fundamental and transformational contribution of information - and its sharing through increasingly agile networks - as means for forming both Enterprises and Systems of Systems, and allowing them to achieve purposeful action.
- Interest in processes in the Enterprise of Development, and how they work towards the satisfaction of goals in the Enterprise of Operations, with the two becoming more closely linked.
- Recognition that architecture plays a pivotal role - both in the design of systems and enterprises, and relationships between the two.
- Concern with integrated management and decision-making, and issues of centralised versus decentralised responsibility for both.

There are nevertheless significant differences, at least in the way in which practitioners see them, with a tendency for ESE to emphasise the social and organisational issues (albeit with a technical dimension) and SOSE the technical/engineering aspects (albeit with a social one). These may be largely cultural but point to separate and legitimate concerns.

Perhaps most fundamentally, we find a shared belief that Enterprises and Systems of Systems are both essentially Systems, and therefore capable of being studied and designed through some combination of Systems Engineering and Systems Thinking, augmented where necessary by Systems Science, Management Science and other allied disciplines.

This paper will present its conclusions, illustrated with pictures and diagrams, in a way that should provide deeper insight into the issues and the state of the art, and equip delegates with a stronger understanding of where ESE and SOS approaches may be best deployed within organisations. There are also implications for further development of the underlying science.



Day 1 : Morning Sessions - Presentation Abstracts

AM - Session 1.2: "Applying Systems Engineering to Enterprises"

11:30 - 12:10

Applying Systems Engineering to Service Delivery

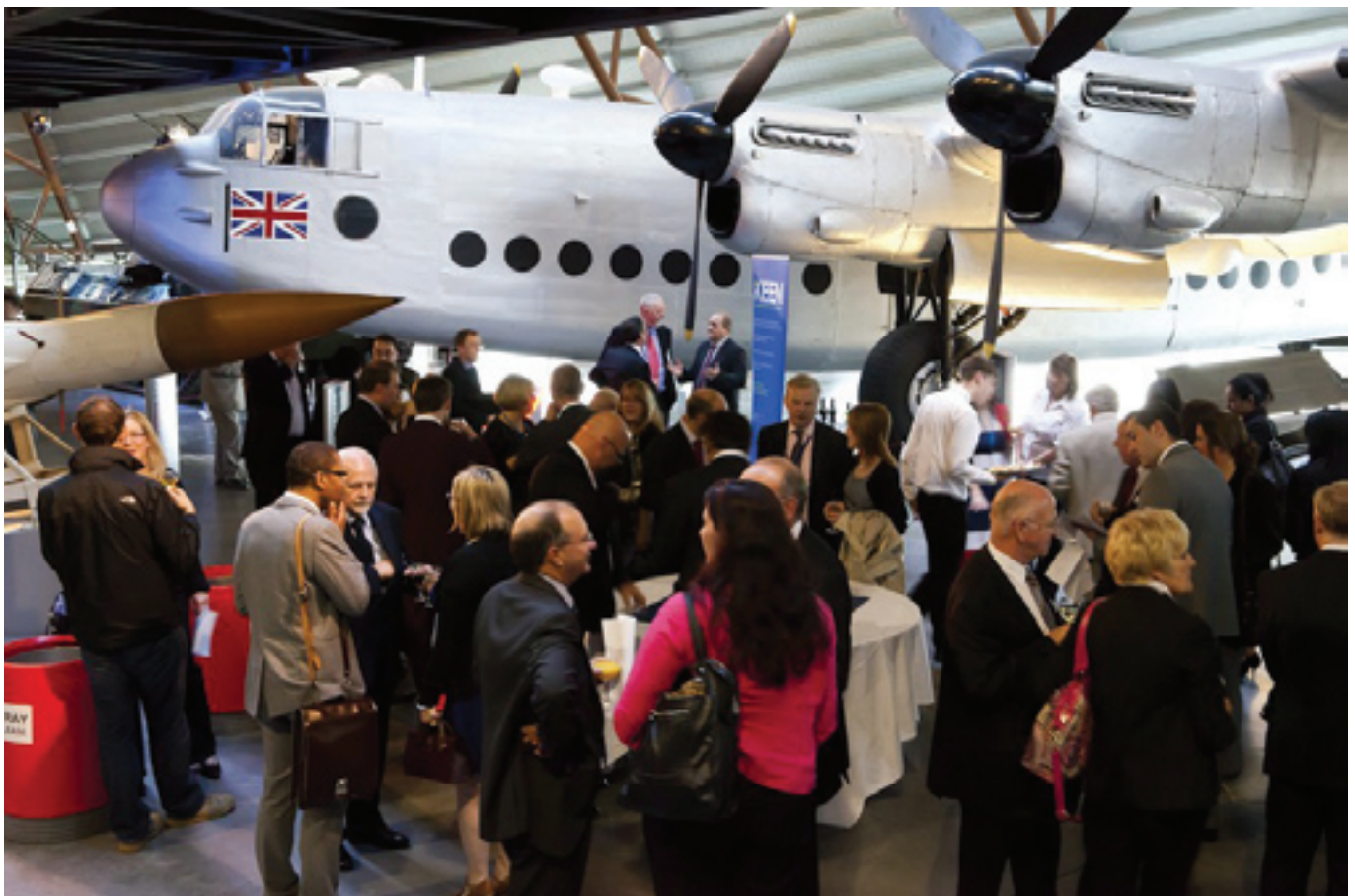
Dan Wilson, (Frazer-Nash Consultancy Ltd)



Systems Engineering has long been applied to the development of physical systems, but the development, specification and management of Service Delivery has traditionally been seen as an activity managed by commercial officers. With the proliferation of service arrangements over recent years covering areas ranging from administrative transport, to equipment support, and to the delivery of health services, the employment of Systems Engineering approaches can deliver real benefits.

Core to a systems approach is to consider a system within its wider socio-technical context throughout its lifecycle. Whilst much focus is often put on the contractual mechanisms put in place, there is less focus on exactly how a contracted service will integrate into the organisation, and how the output can be effectively measured. Getting these elements right both ensures quality of service to end-users, and also ensures that an appropriate level of risk is held by the various parties involved allowing that risk to be managed effectively and ultimately reducing the overall contingency held.

Within this presentation, the application of Systems Engineering throughout the lifecycle of a service delivery will be examined, from the initial specification of the scope of the service, through to the application of verification and validation principles to a service. This means the presentation will also examine how Systems Engineering can provide a means to determine meaningful Key Performance Indicators, alongside ensuring that the contractual arrangements put in place are integrated with internal business change to deliver service required by end-users.



Day 1 : Afternoon Sessions - Presentation Abstracts

PM - Session 1.3: "Delivering Capability in the Transport Domain"

13:10 - 13:50

**Getting It Over The Line -
Delivering a Light Rail System into Service.**
Alan Knott and Adrian Cope



What does it take to get a project 'over the line', to deliver a system into service? Using experience gained from a number of rail and transit projects the authors discuss how the Systems Engineering (SE) practices used throughout the project lifecycle affect the delivery and transfer into service stage and describe one particular, pragmatic approach which has enabled Transport for Greater Manchester (TfGM) to successfully introduce a number of new services on what is now the UK's largest tram network.

The paper introduces the SE practices that have the greatest impact on the 'back end' of the project lifecycle and describes a methodology specifically focussed on bringing an integrated system through the operational readiness, or 'go-live', process and into passenger service.

However, delivery of the system into the operations and maintenance environment is not the end of the project lifecycle. There is the period when the reliability, availability, maintainability and performance needs to be finally demonstrated. Also, many contracts have warranty and defect liability periods and, in reality, there will always be some relatively minor outstanding works and documentation required to complete the delivery. The paper will, therefore, also describe a 'close-out' process that the authors have developed that can help manage this last stage of the project lifecycle.

13:50 - 14:30

Fit for purpose – Transport Architecture Frameworks
*M Brownsword (Atkins), K Gharatya,
G Fletcher (Transport Systems Catapult)*



Architecture frameworks have been applied in numerous domains, not least with forays into transport with frameworks such as TRAK, AutoSAR, EU ITS, etc. However, these frameworks often seem to fail to penetrate the market in terms of application, use and usefulness.

The Transport Systems Catapult is looking to develop thinking in this area by considering the holistic needs of the transportation sector. Around these needs the catapult intends to develop a maturity matrix for the transport domain to assess the capability to deliver coherent, consistent and integrated architectures.

This paper presents the initial development of the maturity matrix and a discussion on the results.



Day 1 : Afternoon Sessions - Presentation Abstracts

PM - Session 1.4: "Interfaces and Agility"

<p>15:00 - 15:40</p>	<p>The System Engineering of Interfaces <i>Hazel Woodcock, (IBM) and Ian Presland, (Thales)</i></p>  <p>Unresolved interface issues, and mishandling of interface requirements, are huge cost drivers in today's complex system projects. More than just running through a standard process, the thinking behind good practice and cost avoidance is explored.</p> <p>This paper has a mix of theory and practical examples, and is focused on information and techniques that can be readily applied. We start with what is special about interface requirements and management, how to conceptualise and how to categorise interfaces.</p> <p>We look at how context diagrams can help in the definition and communication of interfaces, and how this relates to the system design and subsystem specification. The information captured on a context diagram should be more than just the existence of an interface. The context diagram feeds into the N-Squared chart to aid further analysis of the interfaces.</p> <p>Interfaces, and optimisation of interfaces can have a significant impact on overall system partitioning and design, and are key to system architecture.</p> <p>The management of interfaces is covered, from negotiation of external interfaces, to the documentation and specification of interfaces. Effectively flowing down interface specifications to subsystems is a non-trivial exercise, and the type of documentation in place can make a great difference.</p> <p>Traceability is an ever present issue in high process maturity environments, and the right partitioning of information, combined with appropriate tooling is key to maintaining this at an affordable level.</p> <p>This paper follows on from the experiences of running a one day tutorial on the topic, and the worked examples from that tutorial will be shown.</p>
<p>15:40 - 16:20</p>	<p>eXtreme Systems Engineering – Practical Experiences of Rapid and Agile Approaches to Systems Analysis and Decision Making <i>Ian Gallagher and Christian Halconrui, (Altran)</i></p>  <p>In recent times, Systems Engineering techniques have been moving out of the traditional aerospace and defence domain into other industries such as renewable energy, rail, medical devices and automotive manufacturers. Stakeholders in these industries often demand much faster and more agile processes and methods in order to maintain their competitive position in a rapidly changing commercial environment.</p> <p>This presentation shows how innovative and agile Systems Engineering techniques can deliver rapid analysis of stakeholder needs, system functionality, whole-life cost, concept option development and the visualisation of key decisions. These "eXtreme" techniques allow organisations to rapidly conduct studies to Design to Cost, Design to Weight, or maximise the value of a system in another way, during its design or re-design, without degrading critical functional or performance aspects.</p> <p>Reference will be made to both traditional and innovative approaches, highlighting the similarities and differences between them. Examples of the successful application of these methodologies, in a wide variety of industries, and lessons learnt from these will be discussed. The need for strong soft-skills around stakeholder management and process facilitation will be highlighted, in addition to the use of technical methods, tools and analysis techniques.</p>

Day 2 : Morning Sessions - Presentation Abstracts

AM - Session 2.1: "The Future of Systems Engineering"

09:40 - 10:20

The Next 20 Years – Systems Engineering in an Increasing Uncertain Environment
Dave Mawby, (PA Consulting)



The past 20 years have seen INCOSE UK grow from a fledgling to a vibrant Chapter – mimicking the growth of Systems Engineering as a profession within the UK. We now have a maturing body of knowledge on how to engineer solutions with improving integration, lower rework and better project outcomes. There are plenty of examples of this across the UK’s growing Systems Engineering community in aerospace, defence, security, rail and an increasing number of similar domains. We should be proud of the improved delivery assurance that Systems Engineering has enabled us to offer in these sectors.

However, we cannot rest on our laurels. Already there are trends towards more complex systems of systems, enterprise solutions and the extended enterprise. Many of the problems that we are now facing as Systems Engineers in this space are “unprecedented” – there being no prior art on how to solve them. These problems are also getting more complex, with higher degrees of uncertainty and involve a higher proportion of non-technology lines of development.

By means of case studies and examples from his own extensive experience the author will describe how our approach to Systems Engineering needs to adapt to these new challenges over the next 20 years. This journey is likely to involve closer co-operation with disciplines such as Portfolio Management and Programme Management along with approaches such as Soft Systems Methodology. Furthermore, it should not become a methodology war between all of these but the pragmatic adoption and blending together of the best parts of each. This is well illustrated by the combination of Systems Engineering and Programme Management as powerful allies in getting to grips with the definition of some of the UK’s most complex programmes.



Day 2 : Morning Sessions - Presentation Abstracts

AM - Session 2.2: "Model Based Systems Engineering"

10:50 - 11:30

A Model-Based Approach to Architectural Frameworks

Simon Perry, Atego



The concept of an architecture is now seen as essential to any Systems Engineering undertaking and is a core element of any Model-Based Systems Engineering approach. An architecture must cover both the structural and behavioural aspects of the system and should, as advocated by industry good practice, be based on an Architectural Framework (AF). An AF defines a number of allowed viewpoints of a system that any architecture based on the AF can contain, together with consistency rules between the viewpoints. Many AFs exist, such as MODAF, TRAK and Zachman and many organisations will adopt one of these AFs for the development of their system architecture. Unfortunately, this is often done without first assessing the stakeholder concerns that the architecture is to address against the viewpoints defined in the chosen AF, resulting in the adoption of an unsuitable AF that unnecessarily constrains or twists the resulting architecture. If the stakeholder concerns are considered, then the conclusion may be that a bespoke AF is needed.

This presentation discusses a model-based approach to the definition of AFs, the Framework for Architectural Frameworks (FAF). The FAF is based on the concept of an ontology that defines concepts and the relationships between them, defined viewpoints that use the concepts from the ontology and that are organised into a framework. The FAF defines six viewpoints that are used in the definition of an AF. These six viewpoints address the concerns that the AF is intended to address (the AF Context Viewpoint), the concepts that can be represented on a viewpoint of the AF (the Ontology Definition Viewpoint), the purpose, definition and relationships of the viewpoints of the AF (the Viewpoint Context Viewpoint, Viewpoint Definition Viewpoint and Viewpoint Relationships Viewpoint) and the consistency rules for the AF (the Rules Definition Viewpoint). An example of the use of the FAF in the definition of an AF will be given.

11:30 - 12:10

Model-Based Systems Engineering Interoperability in the Automotive Industry

Parham Vasaiely, Jaguar Land Rover



The increasing complexity of modern automobiles and the fact that these systems are designed and manufactured in a distributed manner, represent a significant challenge to the traditional engineering discipline. The application of Systems Engineering as a multi-disciplinary field of engineering can support the automotive engineers by ensuring the pieces of the system work together as a whole, and that the functional and other lifecycle concerns are properly considered to achieve a balanced system solution. Further to the traditional, often document-centric, Systems Engineering practices, the International Council on Systems Engineering (INCOSE) has identified Model-Based Systems Engineering (MBSE) as a key practice for successful Systems Engineering in the future. MBSE promotes a model-centric approach supporting formal and machine-readable models. Another key feature is traceability, the representation of dependencies between engineering data, which requires integration of engineering information across multiple domains and lifecycle phases.

The upcoming INCOSE SYSTEMS ENGINEERING VISION 2025, reconfirmed integration as key for maintaining system integrity, satisfying system requirements, achieving traceability, reducing rework and improving quality at the same time. However, integration of data across disciplines and tools is currently very difficult to achieve due to the lack of an open and common interoperability standard. Here the huge success of the World Wide Web, especially its Linked Data approach, provides an opportunity for the Systems Engineering community to rethink the approach to a common data format.

The aim of this work is to demonstrate an approach for multi-disciplinary lifecycle integration in Systems Engineering, using the graphical modelling language OMG SysML™ and the Open Services for Lifecycle Collaboration (OSLC) in order to support interoperability between the domains and their data, based on standardised and open web technologies. The approach seems to promise a future-proof and scalable solution, which focusses on data and their links or relationships.

Day 2 : Afternoon Sessions - Presentation Abstracts

AM - Session 2.3: "Metrics and Management"

<p>13:10 - 13:50</p>	<p>The Growing Need for Technical Measurements to Control Projects as Reflected in Literature and by Systems Engineering Practitioners <i>Thomas Walworth and Laura Shrieves, (Thales)</i></p>  <p>The need for measurement is well recognised in the literature, both in the engineering disciplines and project management. This is becoming more important as we see an increase in the complexity of projects, and a decrease in the ability of conventional project metrics to predict future performance of projects. Within this area of measuring technical performance of projects, Systems Engineering can be seen as taking the lead from the Software (SW) community. A short exploration of the literature shows how the Systems Engineering community has adapted SW metrics for their own purposes and includes a focus on methodologies to develop key performance indicators. We contrast these ideas with their use in industry through interviews with experienced practitioners. This shows that whilst understanding project progression is regarded as important, it often is squeezed out by more pressing project demands, in direct conflict with the proposed value of Systems Engineering monitoring and control. Interviews additionally reveal conflict between metrics usefulness and difficulty in promoting consistency of measurement across multiple projects. This reasoning lies behind the on-going metrics research at Thales UK, and this research highlights some of those key research activities.</p>
<p>13:50 - 14:30</p>	<p>Synergistic Integration of Systems Engineering and Project Management <i>Paul Hollywell, (Mott MacDonald Limited)</i></p>  <p>Recent research has shown that projects benefit greatly from Systems Engineering (SE) and Project Management (PM) disciplines working closely together. As part of my Masters in Systems Engineering Management at UCL, I have just completed my dissertation that describes research into whether SE could be more closely integrated within a project's PM processes to increase project success for an engineering consultancy.</p> <p>The findings from this research study will be presented in this paper. They will be of interest to conference attendees as the relationship between SE and PM seems to be a 'hot topic' at the moment. This is reflected in last year's formation of the APM/INCOSE Working Group and a similar initiative between PMI and INCOSE in the USA. This subject follows the ASEC theme of reflecting on current SE practice and directing the future of SE.</p> <p>This paper will explore in detail the relationship between SE and PM, in particular the overlap between the two disciplines. A multi-perspective view of their 'intersection' will be presented that describes the concepts, models and potential for synergy. It will attempt to explain why problems sometimes exist with SE and PM disciplines working together. The paper will make some suggestions as to how some of these problems could be resolved as the SE discipline moves forward. Conclusions will be presented that will improve project success as well as guiding further research into this important topic.</p>



Day 2 : Afternoon Sessions - Presentation Abstracts

AM - Session 2.4: "Human Factors and Systems Engineering"

15:00 - 15:40

The Development of the Future Soldier System Architecture - Success and Failure
Paul Sibson, (SEA)



The development of the Soldier System Architecture by SEA in support of the Reducing the Burden on the Dismounted Soldier Capability Vision, was an opportunity to apply a thorough Systems Engineering approach to a complex problem area. Traditionally, each piece of equipment tended to be procured to provide a specific function of the soldier system, procured in relative isolation, without a view to the integration onto the soldier. This resulted in an increasing number of systems being deployed on the soldier without looking at the system as a whole.

To get to grips with this problem, SEA developed a MODAF model of the soldier system, to both capture the current problem, and to develop a functional model of the future soldier. The approach adopted built upon the research by Emma Sparks at Shrivenham in support of the Australian LAND 125 programme. This approach showed how to develop a 'theoretical' model of the soldier, but to support the planned incremental acquisition approach, we combined this with the practical issues of the current system.

The soldier system is the most 'human-centric' system possible, and consequently the key novel development incorporated into this model, is the UML representation of the soldier. This enables the inclusion of all the human functionality within the system and to define all the interfaces between the various systems and the human. This architecture model has stood the test of time, and has been used as the basis for the Generic Soldier Architecture Defence Standard, but the key lesson learnt from this development is that without Systems Engineering support, such models fall into disuse due to lack of understanding in how to exploit them.

This presentation will cover the history and complexity of the model, but also cover the issues of demonstrating its value to non-engineering customers.

15:40 - 16:20

Integrating the Human Element into Model-Based Systems Engineering
Paul Wotton, (Quintec)



The INCOSE Systems Engineering Handbook recognises Human Systems Integration as a key Speciality Systems Engineering Activity. Human Factors specialists have long used models to both analyse Human Factors issues and communicate the results, especially for manning analysis. However this analysis has sometimes progressed in parallel with, but separately from, initial Systems Engineering activities, risking a mismatch between the delivered system, and the manpower resource numbers and skill levels. Integrating manning analysis and Systems Engineering activities has been a priority focus for two major warship projects: the Queen Elizabeth Class Aircraft Carrier and the Type 26 Frigate.

Manning of a Warship System mainly comprises the ship's complement, but includes shore support personnel. All personnel must be suitably qualified and experienced to fulfil the human tasks required by a complex System of Systems, with sub-systems operating in different modes and multiple scenarios. Manning represents the major through life cost, is mostly accommodated and supported by the system of interest and needs numerous different combinations of skill and experience. The cost and safety risks of a mismatch between the manning and delivered system make it a priority to integrate the manning and System Engineering models.

Both the Queen Elizabeth Class Aircraft Carrier and Type 26 Frigate projects use Model Based Systems Engineering for aspects of the project. The manning analysis adopts a Systems Engineering based approach, including modelling. Originally the integration of manning and System Engineering elements was achieved by 'manual' data alignment. To facilitate this alignment data exchange processes are now used. This presentation will describe the current level of integration between System Architect and manning modelling on QEC and T26, and planned developments.

Afternoon Tutorials / Workshops

Day 1: 13:10 - 16:20

Gripping the STEM – Promoting Systems Engineering to the Wider Community *Prof Jon Holt, (INCOSE UK Technical Director)*

In 2014 INCOSE UK is sponsoring a number of Systems Engineering outreach activities in order to promote STEM (Science, Technology, Engineering and Mathematics) - in particular Systems Engineering - to the wider UK community.

In this tutorial, Prof Jon Holt will discuss his experiences performing at a number of Science Festivals, Science Cabarets, radio shows and other STEM-related events over the last ten years.

Jon will discuss how to engage with the wider community using the STEM network and how to develop and construct a presentation or show relating to Systems Engineering themes. The thorny topic of sponsorship will also be presented including how to engage with professional bodies and organisations to promote your STEM activities.

Jon will demonstrate how he has personally used a number of different techniques including magic, mind-reading, escapology and Lego robots as part of his STEM activities.

He will present several of these techniques which will then lead into a workshop to discuss other innovative ideas to promote Systems Engineering which can then be used by delegates to start or continue their own STEM initiatives.

This tutorial will be of interest to any Systems Engineers who are passionate about promoting STEM and Systems Engineering to the wider community.

Robust Design and Design of Experiments Dr. Stuart Burge *(Burge Hughes Walsh Partnership)*

The aim of this tutorial is to provide an introduction to the concepts, principles and practice of Robust Design. Its origin lies with the work of Genichi Taguchi in the 1950s and early 60s and reflects his understanding that customers don't like sensitive systems! Taguchi realised that the performance of a system will be influenced by a number of system design parameters and the challenge is to find the best target or values for those parameters in order to meet or, better still, exceed the performance requirements yet at the same time be robust to the variation that will be experienced in manufacture and use. Taguchi's Robust Design approaches revolutionised the Japanese electronics and automotive industries.

Originally developed as an approach for product design, it is now clear that Taguchi's concepts, principles and practice can apply to the design of any system. It is this universal applicability that makes Robust Design a key skill of any practising Systems Engineer (actually any engineer). Recognised by INCOSE as a key competency, it is unfortunately poorly understood and appreciated, often taught as a "statistical technique" rather than the powerful pragmatic approach that it is.

The tutorial is aimed at those individuals who have an interest in systems design, and will comprise a number of presentation sessions interwoven with practical exercises.

Day 2: 13:10 - 16:20

Just what is MBSE? *Simon Perry (Atego), James Towers (ObjectFlow)*

Just What Is MBSE? An Introductory Tutorial with an Example of Its Application to Architectural Frameworks.

Model-Based Systems Engineering (MBSE) is now seen by many as the way forward in Systems Engineering. But just what is MBSE? This practical tutorial begins by answering this question through consideration of four key topics: the three evils of engineering, the main principles of MBSE, enablers for MBSE and the benefits of MBSE. Following this introduction, delegates will gain practical first-hand experience of MBSE by applying an MBSE approach to the definition of a small Architectural Framework (AF). Working in small groups under the guidance of the tutors, the groups will use the Systems Engineering Modelling Language (SysML) and a defined model-based approach to help them understand the concerns that the AF must address, the Systems Engineering concepts that the AF must be capable of capturing, the architectural viewpoints that the AF must provide, why a particular viewpoint is needed and how a viewpoint is defined.

The workshop element of the tutorial is designed to address the three evils by giving practical illustrations of the principles of MBSE discussed in the introduction: that modelling is more than just drawing, that any view produced in a model has a defined purpose and scope and that the model adds value, is of sufficient quality and is constructed from the most appropriate elements. The issue of how best to present a model will also be discussed

Communication Skills for Systems Engineers *Ivan Mactaggart (Dstl), Kirsty Akroyd-Wallis (MBDA)*

This tutorial is for those who may have to present their work verbally at meetings, written in the form of a report or document, or a combination in the form of a presentation with slides. It is aimed at those who are new to this skill area.

The tutorial will cover 3 main areas of:

- 1 Face to face communication
 - Body Language
 - Barriers to communication
 - Active listening
 - Roles in communication (adult/parent/child)
- 2 Written communication
 - Layout of written information
 - How to get your message across quickly
 - Why grammar and spelling is important
- 3 Presentation skills
 - How to present
 - Keeping to time
 - Preparing the right number of slides with the right amount of information

Throughout these subject areas it will consider themes of understanding your audience and dealing with different types of people in terms of position in the company, different cultures, etc.

Registration and Event Prices

Registration

Visit our online registration facility at:
<https://www.incoseonline.org.uk>

Here you can register for the event, book accommodation and pay by card through a secure payment facility with Lloyds Cardnet via SagePay. Options to pay by cheque or company order are also available.

If you are unable to take advantage of our online registration facilities, please contact the INCOSE UK Secretariat either by email at: enquiries@incoseonline.org.uk or by telephone: 01460 298217 or fax: 0845 280 5304.

Prices and Accommodation

The event prices for INCOSE UK members are:

	1 Day	2 Days
Member Rate	£280	£510
Student / Senior Member	£140	£255

Non-members are welcome, but you will be charged an additional £95 that will give you the benefits of INCOSE membership for one calendar year. Student membership for non-members is an additional £35. The senior rate only applies to those already registered as INCOSE senior members.

Prices include lunch and morning and afternoon coffee on each day.

Overnight accommodation is available at the nearby Park Inn Hotel in Telford and must be booked with the event registration. The cost of bed and breakfast is £100 per night but does not include VAT. Accommodation is charged at cost so there are no discounts or concessions.

The Conference Dinner is included for those registered for the event. Anyone wishing to attend the dinner who is not registered for the event will be charged £35.00.

All prices quoted here are exclusive of VAT (add 20%).

Venue

The venue for ASEC 2014 will be the RAF Museum at RAF Cosford, Shifnal, Shropshire TF11 8UP.
www.rafmuseum.org.uk/cosford

Transportation

Free car parking is available at the venue. A shuttle bus service will be provided to take delegates from Cosford to Telford hotels before and after the Conference Dinner, and again the following morning. However, as the venue is on a military site, all cars left overnight must be registered in advance. We strongly encourage delegates to use the shuttle bus service where possible.

Thank you to RAF Museum Cosford for the use of some of the photographs printed in this brochure.



Directions

For detailed directions, see the venue website:
www.rafmuseum.org.uk/cosford/plan-your-day/maps-and-directions.aspx

Associate or Certified Systems Engineering Professionals (ASEPs or CSEPs)

INCOSE Associate or Certified Systems Engineering Professionals (ASEP or CSEP) receive 1 PDU (Professional Development Unit) for every hour they attend the conference (up to a max 120 PDUs). Furthermore, if you are already an ASEP or CSEP, but are not currently a member of INCOSE, joining INCOSE when registering for ASEC 2014 will earn you an additional 5 PDUs for your year of membership.

About INCOSE

The International Council on Systems Engineering (INCOSE) is a not-for-profit membership organisation founded to develop and disseminate the interdisciplinary principles and practices that enable the realisation of successful systems. INCOSE has grown significantly since its formation in 1990.

Today, there are over seven thousand members representing a broad spectrum – from student to senior practitioner, from technical engineer to programme and corporate management, from science and engineering to business development. Members work together to advance their technical knowledge, exchange ideas with colleagues, and collaborate to advance Systems Engineering.

In the UK, membership numbers have grown steadily, with 50 at our inaugural event in September 1994 in Shrivenham, and rising from 350+ members in 2003 to over 800 members at the end of July 2014. A key goal for INCOSE UK is to achieve a steady and sustained increase in the number of members, further broadening the base of the membership to include new industrial domains.

INCOSE UK's governance arrangements include an Advisory Board which has now grown to over 35 organisations from across industry, government and academia, spanning both traditional and non-traditional Systems Engineering domains.

For more information on INCOSE UK visit our website:
<https://incoseonline.org.uk>

Registration now open - please book early

Please use the online facility at <https://www.incoseonline.org.uk> to register and pay for your attendance.

Then and now, 20 years of Systems Engineering in the UK in pictures.

If you undertake tasks which are characterised by the interaction of multiple conflicting factors across multiple technical and business domains, often exhibiting less than obvious behaviour, then you are either doing, or need to be doing, Systems Engineering, and INCOSE UK exists to help you.



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