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President’s Corner

Welcome to the second issue of Preview of my Presidency. Time is moving rapidly, and I find myself writing these notes on my way back from the INCOSE Symposium 2013 (IS2013) in Philadelphia, PA. In these notes I will be talking about two subjects:

- My reflections from the INCOSE Symposium 2013
- Telling you about my candidacy for the INCOSE President-Elect role

In this edition you will see a summary of news from the Symposium at which over 700 INCOSE colleagues came together for four days of keynote speeches, papers, panel sessions and tutorials as well as business and working group meetings. 25 UK members attended which made us the second largest national representation, and as usual many of our members were actively involved.

Over the week I spent in Philadelphia (I also had working group and INCOSE leadership responsibilities) I was struck by two clear messages which emerged:

- The vital importance of systems thinkers and engineers to address global issues – highlighted in keynotes, panels, and many side conversations;
- The leadership skills necessary to be a successful and influential systems engineer – again the balance of hard/soft skills and the need for a balanced competency set.

My personal highlights were the recognition of three highly valued members of INCOSE UK, and a keynote speech from a leading UK academic.

Congratulations to Professor Patrick Godfrey from the University of Bristol who became one of INCOSE’s newest Fellows recognising his significant personal contributions to the art and practice of Systems Engineering.

Congratulations also to Andrew Farncombe (our Technical Director) and Peter Lister (our Finance Director and a Past President of INCOSE UK) on their INCOSE Outstanding Service Awards, both richly deserved. Both have provided many years’ leadership and service to INCOSE UK and we look forward to recognising their achievements at ASEC 13.

Professor Brian Collins, Professor of Engineering Policy at University College London, continued the strong British contribution, giving a fascinating keynote speech on the essential synthesis between Systems Engineering, System Thinking and Complexity Science. He reminded us how systems engineering was first practiced by Leonardo da Vinci in Italy, codified in France and professionalised in the UK. I am delighted that in 2013 continues to promote professionalism in systems engineering!

The second subject I’d like to share with you is more personal. After discussions over the last few months, and with the generous and continued support of BAE Systems, I have decided to stand for election as INCOSE’s next President-Elect. I believe that my experience both from working for BAE Systems and from leading INCOSE UK I can bring important skills and experience to the role. Clearly leading INCOSE would be a significant responsibility, however I am keen to put in the personal time and energy to make it a success – and in doing so to both serve the INCOSE family and to develop further as an engineering leader.

I have been able to work with John Thomas our current President, David Long our President-Elect, and for a short while David Wright also. John and David Long are excellent leaders and are taking INCOSE forwards in a very positive manner in my view. I would look to build on their work emphasising how we deliver value to our stakeholders, and how we live and promote our INCOSE values.

Like the other candidates in the Autumn elections I will be refining my messages over the next weeks, and in doing so taking care to listen to the widest possible range of opinions. I would urge you to look at the visions for INCOSE that we publish, listen to the traditional President-Elect webinar, and ensure that you use your vote thoughtfully. If you do want to contact me to raise anything, please feel free to.

Alan Harding
President INCOSE UK
president@incoseonline.org.uk

Professional Registration Workshop, Thursday 28th February 2013

I am currently a Principal Engineer for General Dynamics UK. As an engineering company, General Dynamics UK places great importance on gaining chartership and registration, and provided support in my application for chartership through membership of International Council on Systems Engineering (INCOSE).

INCOSE provided valuable guidance through clear communication of the process as well as a one day workshop, which provided valuable feedback on my application.

Whilst at General Dynamics UK, I have worked on a range of programmes from large air defence systems, avionics boxes to leading edge research and development projects. These programmes have given me the opportunity to reflect on the value systems engineering brings in developing appropriate solutions to complex problems.

From reading the introductory material I understood that becoming a Chartered Engineer would provide international recognition of my status as a professional engineer. I have found that being chartered brings respect from both management and peers and is increasingly being recognised by customers.

I would advise anyone thinking of registering for CEng to do so for your own sense of achievement, there will be other benefits, but these are a bonus to the sense of achievement.

Arthur Gordon BSc CEng INCOSE CISSP based in the South-East of England with General Dynamics UK. Registered 2013
Partnership Updates

The Institute of Engineering and Technology

Our partnership with The IET (http://www.theiet.org/) is very important to INCOSE UK, and helps us deliver on our goal to improve the professional status of all persons engaged in the practice of systems engineering.

This partnership was signed in October 2011, and the initial area we have worked on with The IET has been Professional Registration.

Now, INCOSE UK members can access The IET’s Professional Registration services (advisors, the application process, the online career manager tool) via the INCOSE UK website, and get additional administration support from INCOSE UK.

In order to promote INCOSE UK’s role in professional registration Professional Registration Certificates are available to us with INCOSE UK branding, and shortly the national press listing of all new registrants will clear those who have achieved this career step via the INCOSE UK partnership.

We are not standing still with this relationship either. Each year the President of INCOSE UK meets with the Chief Executive Officer of The IET to review the year and discuss priorities going forwards. Last year when I met with Nigel Fine we discussed how well the Professional Registration partnership was proceeding, shared our hopes for the upcoming Engineering Council review of the UK Standard for Professional Engineering Competence (UK-SPEC) and also discussed how in future years the partnership might explore other areas of collaboration which can deliver member benefit for INCOSE UK and The IET.

The Engineering Council

INCOSE UK is a Professional Affiliate of The Engineering Council (http://www.engc.org.uk/). This is an important recognition of our status and professionalism and contributes directly to meeting our goal to maintain our status as a sustainable and professionally managed Learned Society.

Our Professional Affiliate status recognises that we have furthered the knowledge and understanding of our particular area of engineering and technology, and also recognises that our procedures and standards for membership are coherent with the UK Standard for Professional Engineering Competence (UK-SPEC). Most importantly, our status as a Professional Affiliate has entitled us to enter into an agreement with The IET to allow INCOSE UK members to access Professional Registration.

You can read more about the Professional Affiliates scheme in the Professional Affiliates Guide:

I recently attended the Engineering Council AGM, held at the Royal Academy of Engineering on 13th June 2013. This was a good chance to understand more about their priorities, and the issues of interest to the full set of Professional Engineering Institutions (PEI) and Professional Affiliates. While the formal AGM was quite short, Jon Prichard (the CEO of the Engineering Council) took the opportunity to update the group on key activities. I noted the following points which I hope are of relevance and interest:

- The Engineering Council now has an agreed position on how PEI’s should encourage professionally registered engineers to maintain their Continuing Professional Development. This will be formulated into bylaws etc. during the remainder of 2013. At that point, INCOSE UK will review our CPD Policy to ensure that we are fully coherent with latest thinking.
- Led by Dame Sue Ion, the Engineering Council is considering an update of the work of Sir Robert Malpas CBE FREng “The Universe of Engineering – A UK Perspective”. Although over ten years old the original report is worth a read, and we might even consider if/how to promote any topics for inclusion such as systems thinking.
- There is still on-going conversation about the relative positioning and status of Chartered and Incorporated Engineers, and how these two forms of professional registration are marketed. Within INCOSE UK we promote both forms of registration, but my personal view is that the value proposition for Incorporated Engineer status is not as persuasive and differentiated from Chartered Engineer as it should be.

I am looking forward to this year’s meeting where we can once again take stock and consider our next strategic moves.

INCOSE UK

Alan Harding
INCOSE International Symposium 2013 - Summary

This is a summary of key points identified at the International Council on Systems Engineering (INCOSE) Symposium in June 2013. I attended in my role as BAE Systems’ representative on INCOSE’s Corporate Advisory Board, as President of INCOSE UK, and as the co-chair of the Systems of Systems Working Group (SOSWG).

This summary captures the highlights – people are welcome to contact me directly, at president@incoseonline.org.uk, for additional information.

Thanks to INCOSE UK and BAE Systems colleagues who have contributed to these notes: Gan Wang, Richard Beasley, Ivan Mactaggart and Paul Davies.

Overall Themes

The keynote speakers at the Symposium were very strong this year:

- Stephen Welby – Deputy Assistant Secretary of Defense for Systems Engineering, DoD
- Professor Brian Collins – Professor of Engineering Policy, University College London
- Dianne Anderson - Executive Director, Great Lakes Energy Institute at Case Western Reserve University
- John Rader -Vice President, Boeing Tiltrotor Programs, The Boeing Company

The following themes came through from keynote addresses, leadership meetings, and informal discussions:

- The importance of systems engineering and systems engineers to address today’s increasingly complex global issues, wicked problems as we recognise them;
- The crucial nature of leadership – and how we as systems engineers must be effective leaders within our teams, and effective influencers of senior leadership;
- The need to get systems engineering and project management better linked and integrated to ensure effective planning and project execution;
- A continued and growing voice from industry wanting tailored approaches, not “one size fits all”.

INCOSE UK Award Winners

INCOSE Fellow
Professor Patrick Godfrey, University of Bristol receiving his INCOSE Fellowship from INCOSE President John Thomas

Outstanding Service Award
Andrew Farncombe

Outstanding Service Award
Peter Lister
INCOSE Membership Overall Statistics

<table>
<thead>
<tr>
<th></th>
<th>June 2013</th>
<th>June 2012</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Members</td>
<td>9249</td>
<td>8760</td>
<td>+ 5.5%</td>
</tr>
<tr>
<td>Sector 1 – Americas</td>
<td>5479 (44 chapters)</td>
<td>5302</td>
<td>+3.3%</td>
</tr>
<tr>
<td>Sector 2 – EMEA</td>
<td>3059 (19 chapters)</td>
<td>2722</td>
<td>+12%</td>
</tr>
<tr>
<td>Sector 3 – Asia-Pac</td>
<td>711 (7 chapters)</td>
<td>736</td>
<td>-3.3%</td>
</tr>
<tr>
<td>Corp Advisory Board</td>
<td>89 (19 Academic)</td>
<td>84 (17 Academic)</td>
<td>+6%</td>
</tr>
</tbody>
</table>

There is overall steady growth for both individual and corporate memberships despite austere circumstances. INCOSE is looking at how to re-energise leadership succession and membership in some US chapters which are less dynamic than desired. Membership in the Asia-Pacific sector is fluctuating, which I understand to be due to the quite complex and diverse nature of the region. With the International Symposium in Seoul South Korea next year we hope that this can bring some momentum to membership numbers.

SE Professionalism and Leadership

INCOSE continues to highlight the need for effective systems engineering leaders who are skilled in both technical disciplines (both systemic thinking and systematic process knowledge) and leadership/influencing (soft skills).

The David Wright INCOSE Leadership Award will be open for nominations in the Autumn. Over a two year period this award includes mentoring, attendance at international events and support for a leadership project between INCOSE and another professional organisation (PMI is suggested but not mandated). This is an excellent opportunity to develop a future SE leader. Any INCOSE member globally may be nominated.

The number of Certified Systems Engineering Processionals (CSEP) continues to grow, now exceeding 1600 globally (up from 1200 in June 2012), especially in EMEA. While Professional Registration (CEng, IEng etc.) dominates in UK, CSEP is becoming more important as a differentiator for a systems professional, and INCOSE UK will lead a pilot group through certification.

New and upcoming Technical Products

INCOSE and PMI have completed a survey of project managers and chief engineers to address the issue of improving integration of the program management and systems engineering functions. Links to the survey are available through the international INCOSE website at: http://www.incose.org/newsevents/news/details.aspx?id=300.

INCOSE and PMI are also planning a Joint PM and SE practice standard for requirements management bridging between SE and PM. This has the potential to be a very important resource, bridging between SE and PM in this critical area. The work with PMI will require some care to ensure that content, and intellectual property rights are shared and clear – but the upside includes engagement with PMI’s 700,000 members worldwide. This work is part of INCOSE’s outreach to Project Management organisations, noting that as well as PMI there are APM, ICCPM and IPMA which each have differing constituencies.

The INCOSE SE Vision 2025 was launched at IS13, and gives INCOSE a basis from which to inspire and guide, and to engage with other stakeholders from a leadership position. The brochure describing the vision will be published later in the Summer, and I believe will be a very useful asset. Duncan Kemp has been the INCOSE UK representative in this important initiative.

Issue 1.1 of a Guide to the Systems Engineering Body of Knowledge (SEBoK) is now globally available and is becoming increasingly used. It provides carefully written introductions to systems topics, and is well-referenced. We should now be using this as the principal open-source reference for systems engineering subject matter. It can be found at: http://www.sebokwiki.org/

Working Groups

There are 44 active international Working Groups, each with agreed charters and public web pages. All of the working groups are summarised at: http://www.incose.org/about/organization/ti.aspx.

The working groups of most current interest in my view are:

- Systems of Systems Working Group (SOSWG) continues to be active. It has published a SOS Pain Points survey, an
extensive bibliography, and is about to publish a short note listing the most frequently recommended SOS references.

- **Agile Systems and SE Working Group** has now been launched and a significant set of background information on Agile is available from its website.
- **Model Based Systems Engineering (MBSE) Working Group** is very active.
- **Product Line Systems Engineering** – at this time 238 page guide to engineering product line systems is available in French. The group is exploring how to translate to English.
- **Competency Working Group** – is working with the NDIA (US National Defense Industry Association) to develop a *Role-Based Competency Framework* that will extend the existing INCOSE SE Competency Framework into a generic, configurable tool. A key feature will be to align with competency models in adjacent disciplines (e.g. PM, Leadership) to ensure completeness and credibility. This will include:
  - Generic SE roles
  - Typical SE activities per role
  - Classes of SE competency

**Forward Planning – INCOSE diary dates**

- INCOSE UK 19th Annual SE Conference, Heythrop Park Oxon, 12-13 November 2013
- INCOSE International Symposium, Seoul SK, 21-24 July 2014
- INCOSE EMEA Sector Conference, Cape Town SA, 27-30 October 2014

**Academic Matters**

US News and World Report is now listing Systems Engineering (albeit combined with Industrial and Manufacturing Engineering) in its roundup of Graduate courses. While a US-only list it is a good step forwards in visibility for the discipline.

INCOSE student membership is growing, up to 523. Strongest growth is in South Africa with 128 registered in the last six months. Some discussion on whether students should include undergrads; whether % full time can be relaxed from 75% to 25%, and also whether ability to pay for mature (in work) students is taken into account.

INCOSE will hold an academic workshop in the UK in Autumn 2013, this should be an opportunity to better demonstrate the value of INCOSE to other UK universities.

**Industry Outreach**

INCOSE is focussing on four viable and engaged domains, looking to use strategic partnerships to develop influence:

- Automotive
- Biomedical and Health
- Power and Energy
- Ground Transportation

These four domains look like an excellent way of encouraging wider participation in UKAB and in INCOSE UK, noting that Ground Transport (Rail) is already strong in the UK RIG.

**Other Engagements**

Ivan Mactaggart was approached by the Australian Chapter President Ranier Ignatik who was really interested in how the UK Chapter works. Particularly he was fascinated that we have our own advisory board (UKAB) and our own Working Groups. Ivan discusses this in more detail later in the “News from the UKAB” article.

**INCOSE UK involvement**

Congratulations and thanks to all of the INCOSE UK members who put in time, effort and expense to contribute to the Symposium. Apart from all of the leadership meetings, the following members contributed to papers, panels and tutorials – including a Best Paper, and the best-attended paid Tutorial of the symposium. The UK continues to punch well above our collective weight!

Best paper award winners: Duncan Kemp, Rianne Evans, and John Elphick with INCOSE President John Thomas

Rick Adcock (Cranfield University)

- Panel Moderator: “Will the SE Body of Knowledge (SEBoK) change INCOSE and Systems Engineering forever?”
- Panellist: “Stump the Academic: You know you want to!”

Richard Beasley (Rolls Royce)

- Paper: “The need to tailor competency models - with a use case from Rolls-Royce”
- Panel Moderator: “One Size Doesn’t Fit All - But How to Tailor Effectively?”

David Camm (UK MOD)

- Paper: “Steampunk System of Systems Engineering: A case study of successful system of systems engineering in 19th century Britain” (BEST PAPER AWARD)

Paul Davies (Thales UK)

- Tutorial Lead: “The System Engineering of Interfaces”

John Elphick (Atkins)
Riianne Evans (University of Birmingham)

- Paper: “Steampunk System of Systems Engineering: A case study of successful system of systems engineering in 19th century Britain” (BEST PAPER AWARD)

John Fitzgerald (Newcastle University)

- Panellist: “EU-US Collaborative Strategic Research Agenda in Systems of Systems”

Alan Harding (BAE Systems)


Michael Henshaw (Loughborough University)

- Panel Moderator: “EU-US Collaborative Strategic Research Agenda in Systems of Systems”

Duncan Kemp (UK MOD) – SE 2025 Vision,

- Paper: “Steampunk System of Systems Engineering: A case study of successful system of systems engineering in 19th century Britain” (BEST PAPER AWARD)
- Panellist: “How to Influence Colleagues & Decision Makers - the Need, the Path, the Habits”

Nigel Murphy (Atkins)

- Panellist: “How to Influence Colleagues & Decision Makers - the Need, the Path, the Habits”

Andy Nolan (Rolls Royce)

- Paper: “Reducing Scrap and Rework”
- Paper: “How Cost Effective is your V & V?”

Mohammed Odeh (University of the West of England)

- Paper: “Bridging the Gap Between Human Thinking and Machine Processing in Developing and Maintaining Systems”

Derek Price (Network Rail)

- Panellist: “One Size Doesn’t Fit All - But How to Tailor Effectively?”

Clive Roberts (University of Birmingham)


Hillary Sillitto (Thales UK)

- Paper: “Towards a Common Language for Systems Praxis”

Hazel Woodcock (IBM)

- Tutorial Lead: “The System Engineering of Interfaces”

INCOSE IS2013 Photo Gallery

INCOSE IS2013, Philadelphia, PA.

Alan Harding and Derek Price enjoying the refreshments at INCOSE IS2013

Alan Harding accepting Andrew Farncombe’s Outstanding Service Award from INCOSE President John Thomas
2013 Tutorial Day

Twenty seven registrants made the journey to Lydiard House, Swindon, on the 13th June 2013 to participate in one of the three tutorials that ran on the day. By ten to nine Emma Jane and I had handed out all of the name badges, so clearly everyone was keen to get started.

Lydiard House has become our venue of choice for the tutorial day, and once again it did not disappoint. There are some quirks of architecture as you might expect from a Grade 1 listed building, but the layout works very well for the tutorial format. If you have time to look out of the window you can enjoy a view of the extensive gardens that surround the house. Important for INCOSE UK and the registrants, staff are friendly, helpful and efficient and the food is excellent. Lydiard House is also very competitive on price and flexible when adapting to last minute changes. This helps us to keep the price of the event down because it allows us to scale the facilities and the costs to match the numbers attending.

Attendee feedback for all three tutorials was very positive, most importantly including the quality of the learning experience. Here is a sample of the comments:

"Very nice venue, lovely gardens and staterooms in the house."
"Great presenters, good breadth of topics - good discussions and practical advice."
"Very informative day."
"... useful skills to take back."
"Very useful and practical material. I learnt a lot and will be able to pass this to others."
"The content was very relevant to my current situation and it has helped to reinforce much of the information I have been learning recently."
"Enjoyable. Thought provoking. ............... Good presenters, enthusiastic and evangelical, yet understanding of the problems of introducing MBSE."

We were able to offer a wide range of topics covering everything from fundamental SE practise (running successful requirements review), through state of the art process (MBSE for large scale software programmes) to soft skills (successfully managing people as part of the system). Unfortunately there was insufficient take-up to run the fourth planned tutorial on Soft Systems Methodology.

We are most grateful to all of those who prepared a tutorial and set the scene for a successful day:

- Felicity Fashade, Phil Wilson and Paul Lowe all of Raytheon UK
- Sandra Hudson and Fiona Cameron (Sticky Change)
- Paul Davies (Thales) and Hazel Woodcock (IBM)

Thanks are also due to Emma Jane and her team for organising the event in their usual efficient manner.

Tutorial day is run under the Events Committee, led by Ian Gibson, and I usually kick things off with the call for tutorials and organising the selection process so as not to divert too much attention from the major task of organising ASEC. However I hand over to Emma Jane pretty sharpish when it comes to the day-to-day management of the event. If there is anyone who wants to get involved with the Events Committee I would be very happy to hand over my duties next year.

The tutorial day is now an established fixture on INCOSE UK’s calendar, but we continue to review the comments received after each run. We have taken note of the suggestions for future tutorials as well as those related to the running of the event. We are to a large extent dependent on the subjects which are proposed by the presenters but we do steer presenters to cover areas where we perceive there is a demand. We are also looking at ways of advertising the next tutorial day beyond the INCOSE UK membership – we have had some success in this but we need to reach out further.

Of course we have no comments from those who did not attend the event. If you have any comments or suggestions for future tutorial days, whether or not you considered attending this year’s event, please let me know. If you are a potential presenter get your thoughts together for something to offer for June 2014 and stand by for the formal tutorial call that will appear this coming Autumn.

If you missed the opportunity to attend a tutorial this year, make a note to check out what we have on offer in 2014. Details should emerge early in the New Year giving you time to get your claim in for a slice of your company’s training budget.

Peter Lister
Tutorial Chair 2013

Articles from our Members

Alistair Mavin’s interesting and memorable presentation on Authoring Natural Language Requirements using the Easy Approach to Requirements Syntax (EARS) and its extended version EARS+ was, much deservedly, voted best presentation at ASEC 2012.

For this edition of Preview Alistair has kindly provided us with a summary of his presentation which briefly explains the motivation behind this simple approach to writing clear and succinct requirements. He then provides us with some examples of how to structure various types of requirements using EARS and how they can then be further elaborated using EARS+ (highlighted in blue).

Alistair has provided references at the end of the article which provide further information on this approach.
Writing Requirements with the EARS notation   Alistair Mavin

Despite the great number of specialist requirements notations, most people write most of their requirements using natural language (NL). Many of these requirements authors are not trained in requirements writing. In general, they are not interested in learning a new notation, or in following an onerous set of rules of how to write. The Easy Approach to Requirements Syntax (EARS) notation provides one possible solution to this problem. EARS gently constrains NL requirements, is quick to learn and easy to apply. This article gives a brief overview of the EARS notation.

Notation

The EARS template is made up of simple clauses in a specific order that follow an underlying ruleset. Applying the EARS template produces requirements in a small number of patterns, which drives simplicity and consistency.

Within the template, <> denotes a clause, bold clauses are mandatory and normal font indicates optional clauses. Superscripts are used to map clauses between the generic template and examples. Each requirement must have zero or many pre-conditions, zero or one trigger, one or many system responses. The generic EARS template is:

<pre-condition(s)> <trigger> the <system name> shall <system response>

Where,

Pre-conditions define conditions that must be true for a requirement to become active.
Trigger defines a discrete event detected by the system that activates a requirement.
System name must be explicit.
System response specifies the behaviour that the named system must perform as a result of the requirement becoming active.

EARS requirements can be separated into two classes. Normal operation (or “wanted” behaviour), define the system response when all interacting systems and users behave as expected to achieve the desired user outcome (“sunny day” scenario). Unwanted behaviour is used to specify the required system response to any unexpected or undesired behaviour of interacting systems or users (“rainy day” scenario).

The clauses within the EARS template can also be unpacked into sub-clauses to define more detailed and precise requirements using the EARS+ extension.

Examples

For each EARS pattern, the basic EARS template is followed by an example, first with the tagged clauses and then in “pure” NL form. Each example is also unpacked into its full EARS+ form (shown in blue).

A ubiquitous requirement specifies system behaviour that must be continuously active:

The <system name> shall <system response>
The engine control system shall modulate fuel flow
The engine control system shall modulate fuel flow equal to demanded level to engine

A state-driven requirement defines system behaviour that must be provided while the conditions of external stakeholder(s) remain in the defined state:

While <stakeholder> <state> the <system name> shall <action> <object> <comparator> <limit> <direction> <stakeholder>
While engine in icing conditions the engine control system shall send anti-icing command to anti-icing system

An event-driven requirement is initiated only when a triggering event is detected at the system boundary:

When <trigger> the <system name> shall <system response>
When ignition is commanded, the engine control system shall provide ignition
When ignition is commanded, the engine control system shall provide ignition

While <stakeholder>¹ <action>² <object>³ <comparator>⁴ <limit>⁵, the <system name>⁶ shall <action>⁷ <object>⁸ <comparator>⁹ <limit>¹⁰ <direction>¹¹ <stakeholder>¹²

When <aircraft>¹ <commands>² <engine ignition>³, the <engine control system>⁶ shall <produce>⁷ <spark energy>⁸ <equals>⁹ <XX joules>¹⁰ <to>¹¹ <combustion chamber>¹²

While aircraft commands engine ignition, the engine control system shall produce spark energy equals XX joules to combustion chamber

The basic EARS patterns can be combined into complex requirements:

While <pre-condition>¹, when <trigger>² the <system name>³ shall <system response>⁴

While <on ground>¹, when <reverse thrust is commanded>², the <engine control system>³ shall <enable reverse thrust>⁴

While on ground, when reverse thrust is commanded, the engine control system shall enable reverse thrust

While <stakeholder>¹ <state>², when <stakeholder>³ <action>⁴ <object>⁵ <comparator>⁶ <limit>⁷, the <system name>⁸ shall <action>⁹ <object>¹⁰ <comparator>¹¹ <limit>¹² <direction>¹³ <stakeholder>¹⁴

While <aircraft>¹ <on ground>², when <aircraft>³ <sends>⁴ <message>⁵ <equals>⁶ <reverse thrust command>⁷, the <engine control system>⁸ shall <send>⁹ <message>¹⁰ <equals>¹¹ <reverse thrust enable>¹² <to>¹³ <aircraft>¹⁴

While aircraft on ground, when aircraft sends message equals reverse thrust command, the engine control system shall send message equals reverse thrust enable to aircraft

Unwanted behaviour is a general term used to cover all situations that are undesirable, including failures and disturbances, deviations from desired user behaviour, any unexpected behaviour of interacting systems. Unwanted behaviour requirements define the required response of the system to unwanted external events and can be used with other keywords to specify more complex unwanted behaviours.

If <trigger>¹, then the <system name>² shall <system response>³

If <aircraft air data is erroneous>¹, then the <engine control system>² shall <use engine air data>³

If aircraft air data is erroneous, then the engine control system shall use engine air data

While <stakeholder>¹ <state>² if <stakeholder>³ <action>⁴ <object>⁵ <comparator>⁶ <limit>⁷, then the <system name>⁸ shall <action>⁹ <object>¹⁰ <comparator>¹¹ <limit>¹² <direction>¹³ <stakeholder>¹⁴

If <aircraft>³ <air data>⁴ <equals>⁵ <invalid>⁶, then the <engine control system>⁷ shall <use>⁸ <air data>¹⁰ <from>¹¹ <engine>¹²

If aircraft air data equals invalid, then the engine control system shall use air data from engine

Benefits

Applying the EARS+ notation has the following benefits:

- Single format with variable level of detail
- Consistent and universally understandable
- Little training is needed
- Detailed EARS+ requirements are more precise, but still in Natural Language
- No room for "filler text" in detailed EARS+, so requirements are as succinct as is possible
- Clauses of the detailed EARS+ template generate pre-defined terms for reusable library

References


Alistair Mavin, alistair.mavin@rolls-royce.com

It is the intention to encourage members of the UK Advisory board and INCOSE Working Groups to submit articles for future editions of Preview. To contribute an article contact Robbie Forder at: communications-director@incoseonline.org.uk. It should be noted that all published articles represent the views of their Authors and not necessarily those of INCOSE.
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**Content** - PPI updates training content after the delivery of each course, from what is already a standard of excellence.

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“Great course for me, showed the importance of project management principles that I can apply to the software development lifecycle” Delegate, Australia

“Although I knew nothing about the class before I entered, it has helped me put the past quarter century of my life in perspective” Delegate, USA

“Have got a great deal from the course. Thanks! I will personally recommend the course to colleagues and training personnel” Delegate, UK

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**Upcoming delivery dates...**

**Systems Engineering**

London, United Kingdom  28 Oct - 1 Nov 2013
Amsterdam, The Netherlands  13 Jan - 17 Jan 2014
Hamburg, Germany  17 Feb - 21 Feb 2014
London, United Kingdom  24 Mar - 28 Mar 2014
Munich, Germany  22 Sep - 26 Sep 2014
Zurich, Switzerland  29 Sep - 3 Oct 2014
La Spezia, Italy  3 Nov - 7 Nov 2014
Ankara, Turkey  15 Dec - 19 Dec 2014

**Amsterdam, The Netherlands**  25 Nov - 29 Nov 2013
London, United Kingdom  24 Feb - 28 Feb 2014
Amsterdam, The Netherlands  24 Nov - 28 Nov 2014

**Systems Engineering Management**

Amsterdam, The Netherlands  20 Jan - 24 Jan 2014
Amsterdam, The Netherlands  1 Sep - 5 Sep 2014

**Requirements Analysis & Specification Writing**

Amsterdam, The Netherlands  20 Jan - 24 Jan 2014
Amsterdam, The Netherlands  1 Sep - 5 Sep 2014

**Software Development Principles & Practices**

Amsterdam, The Netherlands  14 Oct - 18 Oct 2013
Amsterdam, The Netherlands  10 Mar - 14 Mar 2014
London, United Kingdom  17 Mar - 21 Mar 2014
Amsterdam, The Netherlands  13 Oct - 17 Oct 2014

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TO FIND OUT MORE INFORMATION ABOUT THESE COURSES PLEASE CONTACT US:

PH: +44 20 3286 1995  www.ppi-int.com

contact@ppi-int.com
Who doesn't want their very own light sabre? You can swish it around to make strange noises, change its colour, have it for decoration or even have it as a status symbol (the status of what I'm not sure).

And yet the light sabre has a very humble origin...

A clip of the filming of a face-to-face combat from one of the early Star Wars movies shows light sabres were really like - dull wooden sticks that made a boring thud whenever they came into contact with each other. Computer graphics changed those sticks to beams of blazing light and soundtrack editing altered the thud to a short buzzing noise for the final version of the film. Although I had not expected anything else, it still came as a great disappointment.

Things have moved on. We can now buy toy light sabres. They are not the real item, being light shone down encased tubes. But they are a step closer to what the films were portraying. Will we ever be able to produce real light sabres?

Let us see where a bit of systems engineering can take us.

The basic user requirements of a light sabre are:

1) The User shall be able to cut into various materials
2) The User shall be provided with a blade of less than 2 metres length
3) The User shall be able to instantaneously adjust the blade's length
4) The User shall be able to carry the device easily in one hand
5) The User shall be able to operate the device without using external power sources

The next step would be to identify the list of stakeholders and then to discuss and refine these user requirements. As this would involve science fiction film and publishing industry, as well as research scientists and goodness who else, I think I'll skip this stage. However, this does highlight one thing. It would be a popular project to undertake, which means someone somewhere must have taken this road before me. Well at least you would think so. Or is it hope so?

This immediately suggests to me there is at least one major stumbling block along the way. But let's continue...

We now move onto the main system requirements. They have to be general enough to include every reasonable technological solution. But what would we call reasonable? Do we take into account technologies that are under development and will only be ready some time hence? Or do we limit ourselves to technology we can buy today? This depends on when we want it. I for one want my light sabre, now, today, this very minute. But I'll settle for having it two years hence. So we are talking about mature or near mature technologies.

The main system requirements are:

a) The light blade has to be made of energy (from the instantaneously adjustable user requirement)
b) The energy supply has to be within the light sabre's handle (as the blade is collapsible to nothing)
c) The energy supply has to be very compact (we're not talking about shop bought batteries here unless we find an unusual way of cutting into things)
d) The sabre blade controls shall be on the handle (again as the blade is collapsible to nothing, and also need for instantaneous adjustment)
e) The sabre blade must be easily useable by the human (easily carried in one hand and that instantaneous adjustment)

As with the user requirements, stakeholders should be involved in helping to define the system requirements. Again I'll skip this stage.

So now we have to start thinking about the technologies we can use and the architecture of how it all fits together.

Using a laser for the sabre blade immediately springs to mind. Only there's one main disadvantage. Laser light continues on until it either hits something or becomes so spread out that it appears to have diffused into nothing. So that's no good...

...hold on a minute. That laser has to work in air, doesn't it? What if we can find a way to get the air to stop the laser light? If we can somehow make the air molecules absorb the light energy... this sounds like some for the research and development department to me, but the principle is sound in theory.

It does have one interesting advantage. The amount of input energy could control the length of the blade. Which brings us neatly to another problem, actually controlling the blade length. The quality of air differs from place to place. High mountain fresh air is very different from the humid air of the tropical rain forest. So we'll need a measuring device for the quality of air the light sabre will be used in. And... here's a possible catch... it will need to react very quickly to rapid changes, e.g. opening the door of an air-conditioned heated room onto the snow-covered balcony. This calls for extremely quick timing and accuracy to maintain the sabre's required length. In other words we are talking precision at the atomic level here.

But then if you look over the long history of engineering, one of the major themes has always been seeking and getting better precision in the way components are made and systems are controlled. Think of James Watt and what he needed to do to develop his steam engine. Or think of the difference in spare capacity between the Golden Gate Bridge and the first Severn Bridge that was built much later – yes they had to build a second Severn crossing while the Golden Gate Bridge has taken the extra traffic in its stride.

Our journey to achieve greater precision still continues and one day we will reach the level that is required for the suggested light sabre architecture mentioned above.

Until then, we'll just have to continue playing with the toy varieties or even better, set up workshops at INCOSE conferences to do the systems engineering of light sabres...

I bet there will be a lot of takers for it!

O. B. Server
News from the UK Advisory Board (UKAB)

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

For those of you who have seen the UKAB page in Preview previously you will no doubt agree that the logos represent an impressive collection of some of the UK’s leading organisations, not just from a systems engineering point of view but in that many are household names not just in the UK but on the global stage with incredible industrial pedigree. This not only demonstrates the importance of effective Systems Engineering to these organisations but how they value the opportunity to influence the UK perspective.

If this was not a strong enough example of the strength of the UKAB then consider who our member organisations choose to send to represent them; we count among our members global chiefs of systems engineering, visiting professors and academics from our leading universities, Past Presidents, and senior practitioners from some of the UK’s leading consultancies. As a result of the efforts of this talented and committed group of people and the INCOSE UK Council the UK enjoys a strong reputation globally expressed through the interest shown by other nations in UK activities.

This is clearly demonstrated through a request I received at IS2013 from the INCOSE Australia President. The Australians would like us to share how the UK, through the UKAB and its relationship with the UK Council, has established a robust representation of UK Systems Engineering practice. Specifically how we have enabled this across several strategic industries and academia that is able to directly influence the direction of Systems Engineering not just in the UK but globally.

Since I took over as chair from the excellent Chris Lamb in September 2012, the UKAB has concentrated its efforts to support INCOSE UK’s initiative to advance the professionalism of systems engineering. UKAB members have contributed to the development of INCOSE UK policy and guidance to assist individuals in their Continuing Professional Development and have played a vital part in supporting the agreement with the IET that has seen a fantastic number of Systems Engineers become Professionally Registered (CEng and IEng).

UKAB member and INCOSE International Associate Director for Education, Rick Adcock of Cranfield University is currently working with a number of UKAB members to consider how UKAB and INCOSE UK might support organisations grow and measure their Systems Engineering capability.

A number of issues still dominate SE such as successful tailoring and the development of robust competency frameworks to support organisational development. Additionally, while we are represented strongly in Defence and Aerospace, together with INCOSE UK President, Alan Harding, I would like to see UKAB representation grow specifically in the globally strategic areas of:

- Automotive
- Biomedical and Health
- Power and Energy
- Ground Transportation (noting of course the efforts of the Rail Interest Group)

So if you are a Systems Engineer representing those areas please get in touch.

Ivan Mactaggart
UKAB Chair
ukab-chair@incoseonline.org.uk

Organisations that are interested in joining the INCOSE UK Advisory Board (UKAB) should contact the UKAB Chair, Ivan Mactaggart.
## INCOSE Events Calendar

This calendar is a summary of events at the time of going to press. For the latest, up-to-date information please visit the Events page at the UK INCOSE website: www.incoseonline.org.uk

### Dates for your diary

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Organisation &amp; Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 October 2013</td>
<td><strong>Service Systems Engineering Working Group</strong></td>
<td><strong>Fourth Meeting of the SSE Working Group</strong> To cover the following:</td>
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<tr>
<td>10:00 for 10:30</td>
<td>Qinetiq Farnborough GU14 0LX</td>
<td>- Presentations for ASEC2013</td>
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<td>- Use Cases</td>
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<td>- Characterisation of Services</td>
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<td><a href="mailto:john.davies3@btinternet.com">john.davies3@btinternet.com</a> know if you do not have a British passport.</td>
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<tr>
<td>7 October 2013</td>
<td><strong>Enterprise Systems Engineering</strong></td>
<td><strong>Third Meeting of Enterprise Systems Engineering Interest Group</strong> Presentation on “A framework for the study of Systems of Systems Engineering” will be given by Prof Mike Henshaw, Loughborough University.</td>
</tr>
<tr>
<td>6.30 for 7.00 pm</td>
<td>Defence Academy, Shrinvenham Room WH21</td>
<td><em>This group has already established a strong and loyal following, but is very keen to attract new members who may wish to join us in exploring this interesting and far-ranging topic of growing importance.</em></td>
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<td>Prior booking is essential. In order to provide names to the reception, could you please do so before end of business on Friday 4th October</td>
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<tr>
<td>08 October 2013</td>
<td><strong>Railway Interest Group</strong></td>
<td><strong>MBSE – is there any substance behind the hype ?</strong> To book for this event please contact Bruce Elliott at: <a href="mailto:bruce.elliott@arbutus-tc.co.uk">bruce.elliott@arbutus-tc.co.uk</a></td>
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<tr>
<td>17:00 for 17:30</td>
<td>CH2MHill's offices in Elms House, 43 Brook Green, LONDON W6 7EF</td>
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<tr>
<td>15 October 2013</td>
<td><strong>INCOSE Associates</strong></td>
<td><strong>The 8th IET International System Safety incorporating Cyber Security Conference</strong> Full all the information about this event please visit the IET’s website. The link to the website is: <a href="http://conferences.theiet.org/system-safety/index.cfm?origin=incose">http://conferences.theiet.org/system-safety/index.cfm?origin=incose</a>.</td>
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<tr>
<td>to</td>
<td>Radisson Blu, Cardiff, UK</td>
<td>As INCOSE UK is a supporting organisation, our members can save £100 by registering at the IET Member rate.</td>
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<td>17 October 2013</td>
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<td>Full Days</td>
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<td>12 November 2013</td>
<td><strong>UK Chapter</strong></td>
<td><strong>Annual Systems Engineering Conference 2013 (ASEC2013)</strong> The Programme has now been agreed and the ASEC 2013 Brochure is available for download via <a href="http://www.incoseonline.org.uk">www.incoseonline.org.uk</a>. Booking for ASEC 2013 is now open! <a href="http://www.incoseonline.org.uk/events">www.incoseonline.org.uk/events</a></td>
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<td>to</td>
<td>Crowne Plaza Hotel, Heythrop Park Resort, Enstone, Chipping Norton, Oxfordshire, OX7 5UE (postal purposes only) or OX7 5UF (SatNav).</td>
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<td>Full Days</td>
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<tr>
<td>12 November 2013</td>
<td><strong>UK Chapter</strong></td>
<td><strong>AGM 2013</strong> The Annual General Meeting of INCOSE UK Ltd held in conjunction with ASEC 2013. The AGM is open to all members.</td>
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<tr>
<td>17:30</td>
<td>Crowne Plaza Hotel, Heythrop Park Resort, Enstone, Chipping Norton, Oxfordshire, OX7 5UE (postal purposes only) or OX7 5UF (SatNav).</td>
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