advancing systems engineering

preview

International Council On Systems Engineering UK Chapter Newsletter

Spring conference 2005

This year’s INCOSE UK’s Spring Conference was held on the 9th to 11th May at the Marriott Hotel in Swindon. For more on this year’s event please see pages 5 to 7.

Z1 competition

The INCOSE UK Board embarked on producing a new publication to communicate the meaning and the benefits of systems engineering in simple terms.

The aim is to attract the attention and interest of a wide range of stakeholders, including SMEs, school children, academics and CEOs. Clarity and brevity are key.

To this end, a task group was set up to produce a draft for the Spring Conference in 2005. This task group includes representation from industry (large and SME) and academia who intend to engage the membership of INCOSE as appropriate.

To initiate the process the task group invited all members to enter a competition to submit contributions that address the following two questions:

“what is systems engineering?”

“what are the benefits from systems engineering?”

INCOSE UK received a good set of entries from the Z1 competition and after much debate the following were selected as winners and runners up.

Question –1- WHAT IS SYSTEMS ENGINEERING?

Winner: Timothy Cusk, Network Rail;

“Systems Engineering is “Big Picture” thinking and the application of Common Sense to projects”.

Runner up with a commendation for best explanation targeted at SMEs: Mark Lewis, of Scott Wilson;

“A structured and auditable approach to identifying requirements, managing interfaces and controlling risks throughout the project lifecycle.”

Question -2- WHAT ARE THE BENEFITS OF SYSTEMS ENGINEERING?

Winner: Steve Fielding, Metronet Rail SSL Ltd;

“The benefits from systems engineering are coping with complexity, not being caught out by oversights and misassumptions, managing real world changing issues and producing the most efficient and economic solutions to the need being addressed.”

Runner-up: Jim Brunton, Managed Complexity;

“By using the Systems Engineering approach, project costs and timescales are managed and controlled more effectively by having greater control and awareness of the project requirements, interfaces and issues and the consequences of any changes.”

And a “commendation for best explanation targeted at pupils, teachers and schools in general” went to Colin Brain of SE Validation:

“It is not hard to know when systems engineering fails, because when something important goes wrong it usually makes the news fast. People get killed, buildings fall down, companies go bust, the law becomes involved. But when system engineering goes right, no one notices - which is just how it should be. The computer works when you switch it on, trains run on time, your flight lands on time and no one gets mad.”

Prizes were presented on the Wednesday morning of the Spring Conference.

Thanks to all who entered, and to the Assessment Panel, Les Oliver, Hazel Woodcock, Ken Ashley, Hilary Stilito, Samantha Brown, and Ayman El-Fatatry.

We also drafted a pamphlet, which we put out for review at the conference. We have about a dozen returns with about 30-40 observations, almost all constructive but with some fascinating contradictions. For example, one person thought “Concept of Operations” too jargony while another wanted to insert terms like “validation and verification”. A general feeling was that it was still too defence orientated, despite not one of the winning entries being from a defence person! These inputs will be collated as a set of change proposals and reviewed by the Z1 team.

Your additional views and suggestions are most welcome. A task Group will now progress this forward with a view to producing the next version of the pamphlet for the International Symposium at Rochester in July.

Ayman Al-Fatatry and Hilary Stilito

Please see page 2 for the version launched at SC2005.
In profile - Prof Alan Smith, Academic Liaison - INCOSE UK

I would like to apologise that we are unable to provide the In-profile article for this edition.

Doug Cowper
Editor

In profile next time, Samantha Brown, INCOSE Technical Director

Call for participation/papers
Business Interoperability within the Automotive Sector (BIAS) workshop.

The workshop is affiliated with the 9th IEEE EDOC conference (http://www.edocconference.org) and coordinated with the work programme of the Enterprise Interoperability Cluster activities of the Information Society Directorate-General of the European Commission.

The cluster coordinates the activities of the Framework 6 IT-based projects in the area of interoperability, including, for example, one of our own projects, CrossWork (www.crosswork.info), which investigates the automatic composition of workflows to support collaborative design within Networks of Automatic Excellence.

Further details and more up-to-date information about BIAS can be found on http://www.co.umist.ac.uk/~ndm/CFPs/BIAScfp.htm.

13th IEEE International Requirements Engineering Conference
August 29th - September 2nd 2005, Sorbonne, Paris

RE’05 is an exceptional opportunity to meet in Paris and share experience with worldwide requirements engineering academic and industrial experts. The conference presents a highly selective program of carefully reviewed papers. Besides, a unique forum of exchange is proposed under the form of 12 workshops and 9 tutorials.

This is the occasion to learn about ground breaking requirements engineering methods, techniques and tools. Find out more at www.re05.org

Please email your news and views to dcowper@sula.co.uk
www.incose.org.uk


President's corner

The Spring Conference was a great success with record numbers - 153 total attendance, which I understand is a record. Everything went to time, and almost all the presenters used the INCOSE slide background, so the impression was very consistent and professional. We lost one paper in the second day, which meant we finished at 4.30 instead of 5. I think this was generally welcomed; and since the last session was only 2 papers, there was not the embarrassing rush for the exit halfway through the last session that I have seen at other events. So having a short last session that finishes before the rush hour is maybe something to do again.

It was interesting to see how fundamentally similar are the issues facing widely different sectors, and there was much to learn from this cross-sector exchange for those able to see the parallels. A common issue is how to communicate with a wide variety of non-expert stakeholders. There was a real buzz of intensive networking in all the breaks. I enjoyed it – I hope everyone did as well. I am sure you will want to join me in extending my thanks (again!) to all who worked on this, from all the committee to the board and the UK Advisory Board: "projects" this year, several involving joint work between the UK Board and the UK Advisory Board:

1. Complete the "Z" project
2. Progress the Competency framework to provide coherent and usable outputs for trial use
3. Put in place the "delivery mechanism for policy advice"
4. Keep preparation for EuSEC 06 on track
5. Establish our 5 year strategy and near term implementation plan.

Several younger members at the conference pointed out the benefits to be gained by raising awareness of Systems Engineering within the undergraduate engineering population throughout the university system. Our younger members would be the best people to champion such an outreach initiative. Suitable themes for next year might be "3 U's": EuSEC, youth, and education.

Finally, the next big event at the international level is the International Symposium at Rochester in July. A quick scan of the conference brochure suggests that UK Chapter members are providing 16 papers and 2 reserve papers, and 2 of the panel sessions. This is an excellent contribution that keeps the UK highly visible internationally. Also of course we will get to collect the President's Award and the Gold Circle award. I look forward to seeing many of you there – enjoy!

Hilary Sillitto
President of the UK Chapter

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Events Calendar

**June**

- **29th June 2005**
  - Bristol local Branch AGM (INCOSE members only) followed by Architectural Frameworks Workshop @ UWE (open to all) refreshments provided prior to the event

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**July**

- **10th - 15th July 2005**
  - INCOSE 2005, 15th International Symposium, Rochester, USA

- **17th - 21st July 2005**
  - Twenty-third International Conference of the System Dynamics Society, The Seaport Hotel, Boston
  - http://www.systemdynamics.org

- **16th and 17th November – The Grange City Hotel, London EC3**

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**PEOPLE AND SYSTEMS SYMPOSIUM: WHO ARE WE DESIGNING FOR?**

- **10th - 15th July 2005**
  - Concorde visit @ Airbus, Filton optional social after at local curry house. FULL DETAILS will soon be available on the INCOSE Bristol local Branch website http://www.incose.org.uk/bristol.html

- **19th - 23rd Sept 2005**
  - www.rd05.org

- **16th - 17th Nov 2005**
  - IEE People and Systems Symposium - Who are we designing for?
  - The Grange City Hotel, London

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If you have an event you would like published in Preview then please contact: dcowper@sula.co.uk

Please email your news and views to dcowper@sula.co.uk

www.incose.org.uk
INCOSE UK hosts visitors from Japan

The Systems Engineering Innovation Centre (SEIC) and INCOSE UK hosted a visit by a delegation from Japan representing Japan’s Aerospace Exploration Agency (JAXA), Mitsubishi Electric (Space Systems Department) and Keio University (Faculty of Science and Technology). The visit helped enhance the spirit of cooperation between INCOSE members from both nations with the aim of establishing an INCOSE Chapter in Japan.

The meeting and the visit to the SEIC proved very successful and concluded with a number of actions directed towards supporting the INCOSE membership in Japan through the exchange of information relating to conferences, workshops and training courses as well as collaborative research programme opportunities and prospects in systems engineering.

Dr Ayman El-Fatatry  
Business Development Manager  
Systems Engineering Innovation Centre (SEIC)  
BAE Systems

The Japanese visitors in the SEIC reception with: Hillary Sillitto, Thales and INCOSE UK Chapter president; Ayman Al-Fatatry, SEIC; Christopher Dean, Airbus and INCOSE Director of International Growth; Samantha Brown, BAE SYSTEMS and INCOSE Technical Director; Les Oliver, EADS Astrium and UKAB Chair
Save, save, save!

Renew your membership now by Direct Debit. You should have all received membership renewal papers including a Direct Debit form, except those paying that way already. Direct Debits can only be taken on full year memberships so please submit it now. The INCOSE membership year starts on June 1st so save time as well as money and get it in now! All of you 40% tax payers will save loads and the rest of you a packet too! What is more just think of all the time you will save me: Peter handles the Direct Debits and I can have a game of golf occasionally! Pete does not play golf anyway. What is more he has offered £4 saving to all who pay that way! So only £66 instead of £72. Must be a good deal. Renew today and we will all save.

John Mead
UK Administrator

Advertise in preVIEW

If you are looking to contact the Systems Engineering Community in the UK, why not place an advertisement in preview? For more information about our competitive rates please contact:

John Mead on 01344 422325 or email: john.mead9@ntlworld.com

Spring conference 2005

Dr Iain Watson

This year’s highly successful Spring Conference was the most attended to date! This is fitting tribute to the diverse subject matter submitted and the high quality of presentations. Hopefully, delegates have found it useful and have taken away something, at least, that will add value to their respective companies. Much appreciation goes out to the paper review panel (Paul Davies, Peter Lister, Robbie Forder, Ian Webb and Gordon Woods) and also to the session chairs (Peter Brook, Doug Cowper, David Wright, Hilary Sillito, Derek Price and Gordon Woods) who stimulated debate and kept the sessions to time. I am proud to be stepping down as SEPDC chair on a high note. I would like to extend my special thanks and appreciation to the Board for their help and support during my tenure. I will continue to support INCOSE UK in the Communications and Membership Committee (CMC). I personally feel INCOSE UK has ‘turned the corner’ and is setting itself challenges that will make it into a major force and contributor to the advancement of systems engineering in the UK.

Dipesh Patel
SEPDC

The Spring Conference After Dinner Speaker - John Price, Head of Systems, Airbus UK

Please email your news and views to dcowper@sula.co.uk
www.incose.org.uk
How was it for you?

Having used this title for a number of occasions now I really wanted to find a new one, but failed to find anything better so here it is again. Suggestions for next time welcome.

I was disappointed with the number of questionnaires handed in, 56 out of 150 attendees so we are always looking at a minority view, but many thanks to those who did bother and there were some messages in there that we will need to pay attention to. Timing, which was bad at the Autumn Assembly, was improved, with no more than using the tools which were provided before. Many commented on the strict timing being a big improvement.

To jump to the big picture there was a pretty universal view that it was a most enjoyable and useful event with great networking opportunities etc.

In response to the “What did you not like?” we have “Seating in rows - Poor unreadable slides - Exhibitors in the same room - Difficult in seeing all of the slides - - Exhibitors being in the same room and delegates having a lot more space. Either that or turn people away. This did not give room for classroom style: every one having a table space as we squeezed in for the Autumn Assembly or for Cabaret style. There was not a single complaint about chairs in the Autumn, but now they have become hard again apparently! I would like to have a decision about how many we will cater for on each day of each event beforehand and when we reach that number we take no more bookings - that way we could provide facilities to match and keep every one happy. Yes I know what they thought of it. How many should have had a clear view of the screen and we paid a lot of money for hiring the AV kit, we paid extra money to have a technician stay for three hours the first morning so that any problems could be sorted. I was barely in the room at this time but I assume that the team who were thought that everything was fine. The front rows were empty nearly all of the time so people presumably were not bothered enough to move. When I asked the technician when he came to take it down he said he had not put the screen any higher because the skirt was not exposed the legs! Cannot have tiered theatre style facility is of course the simple answer but we believe in having suitable bedroom accommodation on the same site as part of the package. Not commonly available or only in student accommodation which not all of our delegates approve of or very expensive.

Some of the slides that I saw had proved of or very expensive. Which not all of our delegates appreciated. Some of the slides that I saw had proved of or very expensive. Which not all of our delegates appreciated.

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<table>
<thead>
<tr>
<th>About the venue</th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conference room</td>
<td>15</td>
<td>33</td>
<td>8</td>
<td>1</td>
<td>Visibility of screen from back of hall not good.</td>
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<tr>
<td>Audio Visual</td>
<td>8</td>
<td>22</td>
<td>16</td>
<td>10</td>
<td>Best yet apart from screen positioning. Sound system unreliable.</td>
</tr>
<tr>
<td>Catering</td>
<td>26</td>
<td>30</td>
<td>2</td>
<td>0</td>
<td>Excellent lunch</td>
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<tr>
<td>Accommodation</td>
<td>7</td>
<td>13</td>
<td>1</td>
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<td>Good but too expensive.</td>
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<td>Staff</td>
<td>16</td>
<td>27</td>
<td>3</td>
<td>0</td>
<td>Usual Marriott reliability</td>
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</tbody>
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Marriott staff work really hard and help all they can to administer an event. So what did you think of the venue this time?

I know the numbers do not always add up but they are accurate enough to confirm that they are good at the things that a hotel should be able to do, but were let down a bit specifically on the audio visual.

To a conference organiser who does not know how many we will be catering for the Marriott provided a good basis - half of the Uffington suite for the conference accommodating 100 in theatre style or 54 cabaret ( hotel numbers - with an adjacent exhibition hall ( with the flexibility to do something differently if numbers grew). This flexibility became very valuable as few numbers became apparent and decision had to be made: open up the Uffington into one room necessitating exhibitors being in the same room and delegates having a lot more space. Either that or turn people away. This did not give room for classroom style: every one having a table space as we squeezed in for the Autumn Assembly or for Cabaret style. There was not a single complaint about chairs in the Autumn, but now they have become hard again apparently! I would like to have a decision about how many we will cater for on each day of each event beforehand and when we reach that number we take no more bookings - that way we could provide facilities to match and keep every one happy. Yes I know what they thought of it. How many should have had a clear view of the screen and we paid a lot of money for hiring the AV kit, we paid extra money to have a technician stay for three hours the first morning so that any problems could be sorted. I was barely in the room at this time but I assume that the team who were thought that everything was fine. The front rows were empty nearly all of the time so people presumably were not bothered enough to move. When I asked the technician when he came to take it down he said he had not put the screen any higher because the skirt was not exposed the legs! Cannot have tiered theatre style facility is of course the simple answer but we believe in having suitable bedroom accommodation on the same site as part of the package. Not commonly available or only in student accommodation which not all of our delegates approve of or very expensive.

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Getting Ready For The After Dinner Speaker

Thank you for your comments in the “On anything” category which were wide ranging and interesting. This was probably the only place for thanking the after dinner speaker which you did and for commenting upon multi-track events which we could do if we could guarantee numbers, and will do for the European event in September 06.

Comments on the papers, based on the Best Paper Award sheets that you marked up for us, will be in a separate article.
In theory this should be called the best presentation award as we never manage to do a selection based upon a reading of the papers as we never manage to receive them all in sufficient time for this to happen. So based upon this we are obliged to make the selection based upon the selections that you made on the best paper award forms that delegates completed and returned before departure from the event. This is perhaps the best way as we do get a response from many viewpoints and on this occasion from the 58 who returned a form.

On this basis the top six papers - in running order were: Building the NEC by Peter Brook of MOD DPA, Implementing Architecture Frameworks by Cdr William Biggs also DPA, Interoperability in the Automotive Sector Dr Barbara Jones of PI Group Ltd, Introducing New Technologies in Farming - Getting it right Second time by Michael Emes and Prof Alan Smith presented by Michael, The Reality of Complexity: Are Systems Engineering Models Adequate by Prof. Philip M’Pherson and Multi Modal Transportation Systems Simulation and Modelling by Derek Price and Rachel Bass of Parsons Brinkerhoff Ltd.

This is based upon all inputs received and virtually every paper presented was someone’s favourite and they also all received some negative comment as one would expect when covering such a diverse list of topics in different application areas. The winner on this occasion was none other than Prof. Philip M’Pherson. Well done Philip especially and to one and all speakers for your hard work. Whether winner or not you all made a valuable contribution to this varied programme.

John Mead
UK Administrator

Prof Philip M’Pherson Winner Of The Best Paper Award

Cdr William Biggs

Ian Raper (EADS Astrium) - When Missions Meet

Dr Michael Emes (University College London) - Introducing New Technologies Into Farming

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SC05 some more highlights
“Systems of systems” for example. Everyone is using it, but aren’t all systems made up from other systems?

It’s an awkward expression, when you think about it. Suppose we have one “system of systems,” and suppose we connect it to two or three others; are we creating “a system of systems of systems”?

And so, ad infinitum, like the one about the fleas. And who cares anyway – what difference does it make?

Well, it could matter if it misleads people into misunderstandings, mistakes and down right disasters. What, from a name?

Let’s start at the beginning. What is a system? Well, there are lots of definitions. I expect you’ve got yours – I’ve certainly got mine:

A system is an open set of complementary, interacting parts with properties, capabilities and behaviours of the whole set emerging both from the parts and from their interactions.

Complicated? Not really. Notice that a system is made up from interacting parts. Using that notion, we can draw out a typical system diagram. This is the so-called poached egg diagram, a rather static view of systems hierarchy. Our typical system, the square System of Interest in the figure, sits within a wider, or containing, system, along with two sibling systems all three are interconnected, so that they may interact – in line with the definition of “system” above. The System of Interest contains three complementary sub-systems that are intra-connected, again in line with the definition. And the containing system is also connected to other systems, indicated, but not shown, so it, too, may interact in line with the definition.

So, in this representation we have systems within systems within systems... but do we show any system of systems? The SOI is a system of interconnected sub-systems; the containing system is a system of sibling systems, and there is a higher level still, which we cannot see but can guess at, a system of containing systems.

So, it seems that the term “system of systems” could apply at any level. Or, conversely, at any level we care to choose we can perceive systems, contained sub-systems and containing super-systems. If we decide that our container is really the system of interest, then the SOI and its siblings become sub-systems, within which we would expect to find sub-sub-systems and so on, like those dreaded fleas again. This approach, of simply shifting our view of the hierarchy of systems within systems within systems, is used to manage complexity…

Poached eggs are all very well, I interacting sub-systems include: skeletal, central nervous, cardiovascular, pulmonary, gastrointestinal, immune, and many, many more. Each of these, in its turn, made up from open, interacting sub-systems, creating an organic design, configured on to a set of isomorphic architectures...

Going upwards, hierarchically speaking, from the individual human, we have teams, groups, divisions, organizations, industries, socio-economic units, nations... Actually, you can choose between several routes going upwards, e.g. individual, family, society, county, region, nation...

Let’s try an engineered artefact: a fighter plane. It has many contained systems, too: crew, airframe, propulsion, power, power distribution, displays & controls, navigation, instruments, automatic flight control systems, remote sensing, digital data links, communications, weapons management, weapons, fuel, fuel management, crew environment, and so on. So, is a fighter plane “a system of systems”? And do lots of fighters become “systems of systems of systems”? What about several air defence squadrons flying together: is that “a system of systems of systems”? Does it make much sense, does it?

Notice that the crew were included as a contained system. Without the crew, the fighter plane is just a heavy, leaky rusting pile of junk sitting uselessly on some concrete platform. The fighter’s properties, capabilities and behaviours emerge only when the crew are considered as an integral part of the system.

None of which really helps us to understand “systems of systems.” A system (system of systems) represents a capability to perform a mission...
tion’task...A tank, ship, or airplane are systems...Squads, platoons, companies, battalions...are systems... A Joint Task Force is a system...A supply chain is a system...The Defense Transportation System (DTS) is a system...Do not assign more of the department’s capabilities.”

Now there’s a person who understands what a system is. A system of systems is, after all, simply a system. Here is another definition again from the US DoD, which is even more explicit.

The Future Combat Systems (FCS) is a joint (across all the military services) networked (connected via advanced communications) systems of systems (one large system made up of 18 individual systems plus the network and Soldier—often referred to as a computer or a soldier) linked to these platforms and sensors, has access to data that can provide a much more accurate picture of what’s going on around you, what’s going on around us...[8]

Strange, no one mentioned it at the end— you are unable either to branch, damage the hedge and—without such a transfer function, it is impossible to design systems that work together, that are not affected by parts, that do not make very good Lego bricks. I once heard a program manager demand the “ergo-gnomes” that they provide him with a transfer function for a human operator without such a transfer function, he was supposed to design anything? So, the engineering of systems (EdS) is unable to address teams, operators, users, etc; they are considered to be “outside” of the system; Es makes artefacts for people to use. Peter Checkland once described the systems view of systems as a bag of pool balls; you can put your hand in, take a ball out, examine it, put it back, and still have all the balls intact. Chaos theory has, as you might guess, more to their arrears of understanding. There is a lot of evidence of this happening. [9]

It can get worse: as systems engineers we are all aware of what happens when systems become closely coupled. First they interact more swiftly, and then, as the coupling grows tighter, chaotic behaviour may arise. Chaotic behaviour is really insidious; things appear OK, but every so often, at unpredictable intervals they may be outbursts of erratic behaviour. Subsequent test shows nothing wrong.

Can you detect bottom-up integration in the “engineering of systems”? An obvious sign is that the whole equals the sum of the parts through emergence. Look, too, for signs such as “functional.”
decomposition,″ and the so-called ″V-approach.″ Both of these reductionist paradigms are indicative of ″bottom-up,″ and there are many others.

So, looking at the systems-of-systems phenomenon, are we seeing a resurgence of bottom up integration? Is there an idea going around that we can create a defense capability ″bottom-up″ by networking various military platforms (ships, tanks, planes)? I hope not, but I suspect so. We have been down that road in the past – it is full of potholes.

While folks are getting excited over systems-of-systems and ″engineering of systems″ sagas, they may be missing the real trick – it is full of potholes. None of the definitions given above has hit on the obvious fact that characterize these large-scale systems. There seem to be at least three essentials being overlooked:

- **Cooperation and coordination.** A key feature of what folks are calling systems of systems is that the various independent, viable parts from which such systems are supposedly formed are drawn together so that they may cooperate and coordinate their actions – making them no longer independent, of course, as they become ″part of the system.″ In systems terms, we talk of synergy, cooperation and coordination between the parts to produce desired external effects or emergence; or, perhaps, the whole is greater than the sum of the parts.

- **Whole system features.** A system of systems is a whole system – complex perhaps, but a system nonetheless. So, it will share fundamental characteristics with all systems, such as function, behaviour and form. Functions of the whole system are not functions of the parts. Functions and behaviour of the whole are extensive/systemic. Examples of whole system functions might include, for a defense capability: battle space situation awareness, deconfliction, rules of engagement, threat assessment, decision making, reconfiguration, formation management, etc., etc. None of these functions would be performed by individual platforms, sensors, weapons, etc.

- **These whole system features indicate another major limitation with ″bottom-up″ integration.** With bottom-up, whole system features are limited to what can be provided by, and are accessible in, the building blocks at subsystem level. Systems engineering – the real deal, that is – identifies what is needed of the whole system, and then creates these whole system functions, properties, capabilities, etc., by incorporating appropriate subsystems and by developing new whole system features, too. This way you get what you need – not just what is available.

- **Non-linear dynamics and behaviour.** When a number of complex systems interact, the result is generally non-linear behaviour. The human body example above is typical. Each of our internal organs exists in an environment created by all of the others; they are mutually dependent, yet they all operate in different ways to perform different functions. So, each is enabled by the others.

- **It is this very non-linearity that gives biological systems their high power densities, flexibility, adaptability and wide dynamic ranges.**

The other hand, has little problem with non-linear systems and their design. Non-linear systems may be best viewed using a biological, or organic metaphor, rather than the engineers’ machine metaphor. Open, non-linear dynamic systems are internally active, expending energy to maintain their status. If you were to look inside a recumbent, resting person, you would find their internal systems in a ferment of activity: heart pumping, adrenal glands on the go, central nervous system firing, all five senses active, immune system scouting the system for pathogens, new cells being created to replace those reaching the end of their lifecycle, and so on...and all of that is just to maintain the status quo. Not much like a machine, then...

Networking a collection of sub-systems together can certainly contribute to creating a system, but the systems approach to addressing that new system (or systems if you will) is to look at the whole system, rather than its parts. The figure below shows a whole system of interest (SOI), on the left, in context. Let us call it Blue System. Blue is seen in system within its environment, without any interaction.

The first thing to notice is that, as Blue acts on Red, Red is changed, and vice versa. So, each of the protagonists affects the other’s effectiveness, performance, etc., continually and dynamically. The other point that hits you is that you are not seeing any subsystems – this is not the poached egg diagram rehashed (sorry). Instead you are seeing only aspects of the whole system – no Cartesian reduction, no decomposition, no disaggregation.

Any system can be considered as having being (form), being capable of doing (function) and perhaps even of thinking (behaviour) – a system of systems is no different. ″Doing″ requires function management, which has aspects of mission management, resource management and viability management. Remember, these are aspects of the whole system, not its parts/subsystems. Each of these whole system management aspects can be elaborated as shown in table 1.

In addition to whole system features of function management there will be features of whole system behaviour management and whole system form management (10). None of these different aspects exists in isolation; they are all contemporaneous and mutually effective. In designing the whole system, then, it is necessary to start at the top and work down (hence systems engineering is...
**Bristol**

The Bristol Local Group’s last event was held in April. The event was a panel discussion chaired by George Capel and debated the question “What is Most Important to System Design Success: Models, Design Documents, Process or Something Else?”

In the follow-up questionaries to this event, there was a general consensus that the material presented was clearly a 3D transformation of the V model, and while great claims were made for its power and flexibility, just adding the related processes meant the drawings had to be oversimplified. In general terms it had something going for it, but was not nearly as a) mature, or b) original, as the presenter obviously felt. And unfortunately at times the presentation lacked an organized approach and did lose its way.

This, however, did lead to what felt like a much more interactive debate than it might have and although the audience didn’t agree with a lot that was presented, the discussions and feedback from the audience was stimulating. George clearly has much practical experience to offer the system engineering community.

One member of the audience raised the question of whether some mechanism for further e-mail discussions on topics presented could be established, so that we could put all our questions and comments to the presenter.

Simon Hutton, the CMC Chair, will be “keeping these ideas running until we have an opportunity to make something happen”.

The next event is planned for June 29th - INCOSE Bristol local Branch AGM (INCOSE members only) followed by Architectural Frameworks Workshop @ UWE (open to all) refreshments provided prior to the event.

Full Details will soon be available on the INCOSE Bristol local Branch website: [http://www.incose.org.uk/bristol.htm](http://www.incose.org.uk/bristol.htm)

Timetable of events for the next season (starting in September 2005) will also be published in the next issue of Preview and on the website.

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**Table 1 System Management Aspects**

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Mission Management</th>
<th>Resource Management</th>
<th>Viability Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Collect information</td>
<td>Acquire resources</td>
<td>Synergy</td>
</tr>
<tr>
<td>2</td>
<td>Set/Reset objectives</td>
<td>Store resources</td>
<td>Homeostasis</td>
</tr>
<tr>
<td>3</td>
<td>Strategize and plan</td>
<td>Distribute resources</td>
<td>Maintenance</td>
</tr>
<tr>
<td>4</td>
<td>Execute plan</td>
<td>Convert and utilize resources</td>
<td>Survival</td>
</tr>
<tr>
<td>5</td>
<td>Cooperate</td>
<td>Discard excess waste</td>
<td>Evolution</td>
</tr>
</tbody>
</table>

“top-down” as opposed to engineering systems which is “bottom-up.”

Additionally, and importantly, there will be a whole-system concept of operations, or ConOps, which describes how the whole system is intended to work. The ConOps requires that the whole system possess/exhibit whole system functional capabilities (prime mission functions). It is these prime mission functions that are directed by Mission Management and supplied by Resource Management, while Viability Management ensures that the whole system continues to be able to “do its stuff.”

So far, we have not mentioned the subsystems, which, in the case of a defence capability, might be platforms, teams, troops, squadrons, etc. A sensible way to look at these subsystems is as a substrate, upon which to lay the whole system functional and behavioural management features. Whole system functions may exchange information “upwards and downwards” with subsystems, but coupling will be loose, and such as to obviate the risk of creating lateral meshes of interlinked function between platforms.

So, there are sensible ways to understand and synthesize complex systems from complex systems, and if you want to call complex systems by names such as “system(s) of systems,” that’s fine. But please, please, do not think, like every teenager discovering sex, that you have just found something new. If you want to create “systems of systems,” for heavens sake use the tried and trusted systems approach! They are just systems, after all...

Oh! I nearly forgot; is it possible to define a “system of systems?” Looking at the definitions above, it is clear that 1) there are some confused puntists out there; 2) some folks are using the term willy-nilly; 3) there is no consensus of what the term means; 4) some folks are seeking to capitalize on the confusion. So I now offer you a definition of the term:

A system of systems (SoS) is an open set of complementary, interacting systems with properties, capabilities and behaviours of the whole SoS emerging both from the systems and from their interactions.

If you look back, that is just my definition of a system, with a simple hierarchy shift...

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**How do you get involved with regional activity?**

**Are you looking to participate in local INCOSE activities?**

**Are you looking to set up a regional group?**

For more information about regional activities or how to get about setting up a regional group, please contact:

Simon Hutton on 01229 838867

or

email: simon.hutton@threesl.com

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**Gordon Woods**

(on behalf of the Bristol Local Group).

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**Who to contact**

**President of the UK Chapter**
Hilary Sillitto
Thales Optronics
1 Linthouse Road, Glasgow, G51 4BZ
T: 0141 440 4961
F: 0141 440 4001
E: hilary.g.sillitto@uk.thalesgroup.com

**Treasurer**
Peter Lister
Siemens Transportation Systems Ltd
4 Highlands Court
Cranmore Avenue
Shirley, Solihull, B90 4LE
T: 0121 7134311
F: 0121 7134360
E: peter.lister@siemens.com
peterlister21@2sc.com

**Immediate Past President**
Prof. Phil John
Cranfield University
RMC Shivenham, Swindon, SN6 8LA
T: 01793 765720
F: 01793 763192
E: p.john@rmc.cranfield.ac.uk

**Past President**
Paul Davies
Technical Manager
Thales Sensors
Scudamore Road, Leicester, LE3 1UA
T: 0116 2954174
F: 0116 2786767
E: paul.davies@ukthalesgroup.com
paul.davies523@ntlworld.com

**President Elect**
Position Vacant.

**UK Administrator**
John Head
20 Beehive Lane
Binfield, Berks, RG42 8TU
T: 01344 422325
E: john.mead9@ntlworld.com

**Secretary**
Allen Fairbairn
Elipsis Ltd
3 Trinity Road,
Folkstone, Kent. CT20 2RQ
T: 01303 850255
F: 01303 246265
E: allen@elipsis.com

**Chairman of the SEPDC**
Dipesh Patel
Systems Engineering Consultant
T: 0207 266 0696
E: pateldipeh9@aol.com

**IEE Liaison**
Doug Cowper
Sula Systems Ltd
Old Crown House
Market Street
Wotton-under-Edge
Gloucestershire GL12 7AE
T: 01453 844660
E: dcowper@sula.co.uk

**Chairman of the CMC**
Simon Hutton
8 Inglewood
Barrow-in-Furness
Cumbria
LA14 2RJ
T: 01229 838867
E: simon.hutton@ocs.org.uk

**Academic Liaison**
Prof Alan Smith
Centre for Systems Engineering
Mullard Space Science Laboratory
University College London
Dorking, Surrey
T: 01483 204147
E: a.smith@msl.ucl.ac.uk

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**President of the UK Chapter**
Hilary Sillitto
Thales Optronics
1 Linthouse Road, Glasgow, G51 4BZ
T: 0141 440 4961
F: 0141 440 4001
E: hilary.g.sillitto@uk.thalesgroup.com

**Treasurer**
Peter Lister
Siemens Transportation Systems Ltd
4 Highlands Court
Cranmore Avenue
Shirley, Solihull, B90 4LE
T: 0121 7134311
F: 0121 7134360
E: peter.lister@siemens.com
peterlister21@2sc.com

**Immediate Past President**
Prof. Phil John
Cranfield University
RMC Shivenham, Swindon, SN6 8LA
T: 01793 765720
F: 01793 763192
E: p.john@rmc.cranfield.ac.uk

**Past President**
Paul Davies
Technical Manager
Thales Sensors
Scudamore Road, Leicester, LE3 1UA
T: 0116 2954174
F: 0116 2786767
E: paul.davies@ukthalesgroup.com
paul.davies523@ntlworld.com

**President Elect**
Position Vacant.

**UK Administrator**
John Head
20 Beehive Lane
Binfield, Berks, RG42 8TU
T: 01344 422325
E: john.mead9@ntlworld.com

**Secretary**
Allen Fairbairn
Elipsis Ltd
3 Trinity Road,
Folkstone, Kent. CT20 2RQ
T: 01303 850255
F: 01303 246265
E: allen@elipsis.com

**Chairman of the SEPDC**
Dipesh Patel
Systems Engineering Consultant
T: 0207 266 0696
E: pateldipeh9@aol.com

**IEE Liaison**
Doug Cowper
Sula Systems Ltd
Old Crown House
Market Street
Wotton-under-Edge
Gloucestershire GL12 7AE
T: 01453 844660
E: dcowper@sula.co.uk

**Chairman of the CMC**
Simon Hutton
8 Inglewood
Barrow-in-Furness
Cumbria
LA14 2RJ
T: 01229 838867
E: simon.hutton@ocs.org.uk

---

**Please email your news and views to dcowper@sula.co.uk**

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