

# the system

Systems Engineering Innovation Centre  
Integrating people, processes, tools and  
technology to create tomorrow's business  
and product solutions.

NEWS FOR SYSTEMS ENGINEERS  
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## Decisions, decisions

**M**aking everyday decisions can be hard enough at the best of times and something we often attempt to postpone or avoid. When the decision in question has the potential to impact far and wide, both now and into the future, and affect the lives of thousands of people, this is something most of us would rather not even contemplate! Now consider that such a decision must be also made under time pressure and by synthesising and analysing a multiplicity of data from a multitude of sources and you begin to understand the challenge facing today's defence leaders.

The requirement for industry to fully support the provision of defence capability and contribute to its management through time (TLCM – see panel top right), rather than simply supply kit and spare parts, is well established but for industry to play its full role it must also apply its ingenuity to complex information management. Why? Because meeting capability needs can never be balanced unless someone makes those difficult decisions: sound military judgement will always be essential, supported by accurate, relevant, reliable and timely information, but judgement hangs crucially on the decision-maker's ability to access, absorb and process this information, sometimes quickly and in stressful situations.

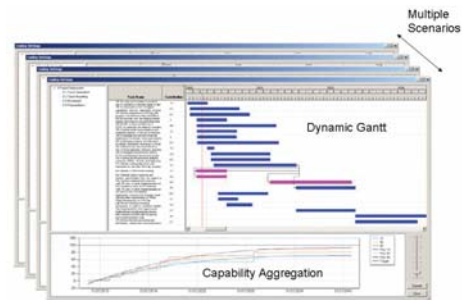
In response to this challenge, Salamander and BAE Systems have developed an approach called TRAIIDE™, TLCM Robust Acquisition inclusive Decision Environment. TRAIIDE provides evidenced information via specially designed visualisations which highlight consequences, articulate options and so inform and support crucial decision making. TRAIIDE is about providing evidenced information to inform the capability planning cycle and debates, leading to more cohesive and coherent options. By managing and presenting information in an intuitive, faithful visualisation, it becomes useful intelligence. The resulting improved representation guides better understanding of the organisation or situation as it actually exists. Improvements are therefore enabled, for example, better balanced solutions, efficiency/effectiveness gains and waste reduction.

Systems engineers at the SEIC are playing a central role in transitioning TRAIIDE towards design maturity by

- Integrating leading COTS toolsets with the framework
- Devising demonstrations exercising TRAIIDE visualisation concepts within a TLCM context
- Facilitating the transition from vision to operational tool
- Creating innovative modelling solutions to overcome information gaps
- Developing capability aggregation concepts
- Exploring how these novel visualisations may be used in an effective and robust manner

No less than in the defence world, the ultimate goal of any business or organisation must be to maintain or improve its capability to competitively and efficiently meet current and future challenges. Where new or different capability is demanded, change is inevitable. TRAIIDE™ is a tool which supports the planning and management of necessary change/s and thus has the potential for almost universal application.

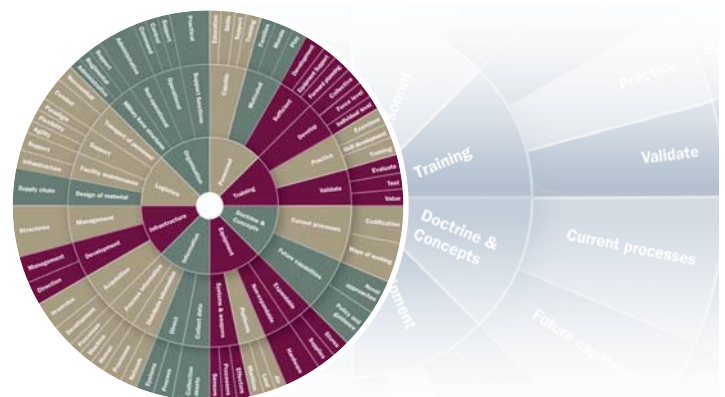
**Through Life Capability Management (TLCM)** is "an approach to the acquisition and in service management of military capability in which every aspect of new and existing military capability is planned and managed coherently across all Defence Lines of Development (DLoDs) from cradle to grave." (Tom McKane, Enabling Acquisition Change, June 2006)



The Dynamic Gantt (above) is one of a range of novel visualisations used within the TRAIIDE framework. This allows the impact on readiness to be assessed when programme components across all DLoDs are rescheduled or cancelled. This is integrated with other visualisations such as the novel 'Bullseye' diagram (below), which allows the impact on capability to be effectively communicated.

TRAIIDE is focussed on providing:

- Information management as a key enabler to TLCM
- Connected and continuous trade-off support to the MOD's Capability Planning Process



For further information on the SEIC contribution to TRAIIDE, contact David Battersby (d.j.battersby@lboro.ac.uk) or Prof Roy Kalawsky (r.s.kalawsky@lboro.ac.uk)

For further information about TRAIIDE, contact Bob Barton (bob.barton@baesystems.com) or Dick Whittington (dick.whittington@tsorg.com)

TRAIIDE is a unregistered trademark of BAE Systems.

# Event celebrates five years of successful partnership

**R**epresentatives from Loughborough University, BAE Systems and the East Midlands Development Agency (emda) recently gathered at the campus to celebrate five years of successful partnership.

The organisations joined forces in 2002 to establish the SEIC at the University's Holywell Park. The SEIC was established to develop innovative solutions in systems engineering by leveraging systems research from across the University. Systems Engineering is increasingly being recognised as a discipline that can add enormous value to organisations who produce complex systems. Also massive benefits can be realised if a systems approach is followed in other sectors (construction, healthcare, rail, medical technology etc.) – this is not just restricted to the defence sector. The SEIC addresses these challenges not because they are easy, but because they are hard and the rewards really can make such a massive difference to an organisation's competitive advantage.

Peter Winter, Loughborough University's Pro Vice Chancellor for Enterprise said: "The collaboration between BAE Systems, emda and Loughborough University is an outstanding example of what can be achieved by working closely in partnership. The SEIC confirms Loughborough University's position as a world leader for research and teaching of Systems Engineering. The last five years have seen SEIC potential in this area go from strength to strength, building even more international collaborations and profile to further increase the prestige of the University and the East Midlands."

Mark Reason, Commercial Director Shared Services of BAE Systems, added: "The need to work in a collaborative environment that fosters knowledge sharing and transfer is a critical element for BAE Systems in developing new technologies and capabilities. The SEIC is a prime example of such an environment."

Mike Carr, emda's Executive Director of Business Services said: "emda is delighted to continue to work alongside BAE Systems and Loughborough University to support the SEIC. It is a nationally renowned centre of excellence for Systems Engineering, which provides businesses with a focal

point from which they can access information, training, research funding and a range of other valuable services.

"emda is committed to encouraging and supporting innovation in the region and the SEIC is a tremendous resource that companies in the East Midlands can utilise in order to generate new ideas and products that will provide them with a competitive advantage."



Pictured from the left are Peter Winter, (Pro Vice Chancellor, Enterprise, LU), Professor Neil Halliwell (Deputy Vice Chancellor, LU), Professor Shirley Pearce (Vice Chancellor, LU), Alastair Imrie (Group HR Director for BAE Systems), Michael Carr (Executive Director of Business Services at emda), Mark Reason (Commercial Director Shared Services of BAE Systems) Phil Greenway (Management Head, SEIC) and Professor Roy Kalawsky (Technical Head, SEIC).

Partnership can take many forms. If your company would like visit the SEIC to discover more about the different ways and benefits of working with the SEIC, please email to Professor Roy Kalawsky ( r.s.kalawsky@lboro.ac.uk) or Phil Greenway ( p.greenway@lboro.ac.uk)

## In Memoriam

### PROFESSOR MICHAEL ANTHONY WOODHEAD

BSc, PhD, CEng, MRAeS, MAIAA 1944 – 2007



Mike began his long and distinguished career as an undergraduate apprentice with A V Roe & Co in 1963 going on to work in the Aerodynamics Department, Flight Simulation and Flight Control Sections at Hawker Siddeley Aviation until 1968. He gained a PhD in 'Synthesis of Optimal Modal Control Systems' from the University of

Salford in 1972. While at Salford Mike built an international reputation in Systems Engineering, particularly with regard to the development of super-value, advanced technology, highly integrated complex systems for the defence industry.

While at Salford Mike worked with the USAF Flight Dynamic Laboratory at Wright Patterson AFB for many years on the development of active control applications for the YF-16 and Advanced Fighter Technology Integration programmes. From the mid-1980s, his interests widened to include land and sea systems and his long-term association with BAE Systems involved both research and the development of new Systems Engineering courses for the company. The first Advanced Systems Engineering MSc Course was offered in 1987 followed later by the one week short course in Systems Engineering:

both of these courses are still servicing the needs of BAE Systems engineers today.

In 1998 he was headhunted by Loughborough University to take up a position as Professor of Systems Engineering where he played a key role in establishing the Systems Engineering Innovation Centre and continued to work with a range of national / international industrial and academic institutions on defence related topics such as evolvable systems, 'smart' and 'open' systems architectures, architectures for intelligent autonomous systems, decision making in autonomous systems and Systems Engineering techniques for capability development. In recognition of his expertise he became UK Panel Member for the NATO Systems Concepts and Integration Panel, a member of the UK National Advisory Committee for Systems Engineering and of the Royal Academy of Engineering Working Party on Systems Engineering.

Mike had huge experience of applying systems ideas and approaches to the development of large scale defence systems – he was a 'real' Systems Engineer and his knowledge and unique perspective will be sadly missed.

# Companies collaborate to support engineers of the future

Regular readers of this newsletter will not need convincing that systems engineers are urgently needed in all sectors of the UK economy so we are delighted to report a new initiative to encourage and support the next generation of these important people. Three major UK companies - BAE Systems, SELEX Sensors and Airborne Systems and Frazer-Nash Consultancy Ltd - have signed an agreement with Loughborough University to sponsor its undergraduate programmes in systems engineering.

Today, the demand for systems engineers is increasing in proportion to the need for successful integration of many strands of engineering, scientific and technical knowledge. From the start, BAE Systems' commitment to the programme and its sponsorship and involvement guaranteed that this would be a highly industrially focused and relevant course of study where the 'end product' was a fully formed, albeit fledgling, systems engineer. The company has now employed over two hundred graduates from the course and reports significant benefits. The new recruits bring a broader background in 'systems thinking' which enables them to raise the capability of any team in which they work. On average, they progress more quickly than their counterparts and are also attracted to roles in new areas such as unmanned vehicles and future concepts where their systems engineering skills can be used to good effect. Despite competition to employ these graduates – and they are much sought after by other companies and other sectors – BAE Systems is as keen as the university to welcome additional interest and support from new partners and the increased breadth of perspective and fresh industrial input this new initiative promises.

## How does the collaboration work?

Companies pay an annual membership fee (£2,500) and a pro-rata payment (£800) for each of the undergraduates they choose to sponsor individually. The extra financial injection is used by the university to enrich and extend the students' learning experience beyond what is normally expected, even at MEng level. In return, companies participate in the development of the course content to ensure its continued contemporary relevance and alignment with their projected future needs. Crucially, their involvement will also help raise awareness of the discipline of systems engineering amongst students, parents, teachers and careers advisors. Though the university retains overall control of the curriculum and remains responsible for the integrity and standard of academic content, this is partnership in practice, not just theory, which provides a tailored education and an enhanced learning experience for all students on the programme so that they are equipped to hit the ground running when they join their sponsoring companies.

As John Hooper, the Department of Electronic and Electrical Engineering's Director of Education Partnerships, observes, "If we don't have enough systems engineering talent in the UK, we will not be able to compete on large-scale, technical, global projects so I am delighted with the confidence which our partner companies have placed in this distinctive undergraduate programme and wholeheartedly welcome the additional strength their combined support will add to the learning experiences of our students. There really is nothing quite like this degree in any other UK university. The Royal Academy of Engineering recently called for universities to meet the challenge of teaching systems engineering and I feel Loughborough is setting a trend that other engineering faculties will follow."

*companies participate in the development of the course content to ensure its continued contemporary relevance and alignment with their projected future needs.*



Systems engineering undergraduates put the final touches before presenting their project

## A bit of background

Over fifteen years ago, Loughborough University worked with the then British Aerospace to design and develop this pioneering undergraduate degree to fill a specific skills gap in their aerospace and defence project teams. One of the unique features of the programme is its delivery model which remains an exemplar of academic cooperation: managed by the Department of Electronic and Electrical Engineering and accredited by three major engineering institutions\*, the core programme is taught by no less than seven departments with a further five departments contributing modules.

In addition to the original broad-based general course where undergraduates have open module choice, there are now four focussed streams each with a set of pre-determined module options selected to give undergraduates competence in either Aeronautical, Control and Power, Renewable Energy or Human Factors. Discussions are underway to offer other themes in response to industry demand.

\*The Institution of Engineering and Technology (IET), the Royal Aeronautical Society and the Institute of Measurement and Control

If your company is interested in joining the collaboration, contact John Hooper, (j.g.hooper@lboro.ac.uk)

For further information about the programme, visit [www.lboro.ac.uk/systems](http://www.lboro.ac.uk/systems)

# In the News



## Success in Advanced Systems Engineering MSc

The Loughborough University MSc in Advanced Systems Engineering was awarded to Tony Day, Steve Yarrow and Tom Grundy - special congratulations go to Tom, who was awarded a Distinction – and a Diploma in Systems Engineering was awarded to Steve Moss and John Lomax, all of BAE Systems' Military Air Solutions. Diplomas also went to Andy McBride of MBDA and Alan Donald of Land Systems. The graduation ceremony which took place in December represented the culmination of a lot of hard work over a number of years – well done everyone!

## Would you like to do the same but can't commit so much time at the moment?

If you want to take a single MSc module as a short course, that's ok. If you want to gain credits towards a future pgCert, pgDip or MSc, you simply elect to complete the assessment in the usual way. For example, the Advanced Systems Engineering MSc module "Systems Approach, Analysis and Concepts" ran in October with a cohort comprising Engineering Doctorate students, MSc Students and 'casual' students choosing to undertake just the short course. The latter group had the option to complete the accreditation and bank points towards a future postgraduate qualification but it was not compulsory. More information is available here: [www.seic-loughborough.com/shortcourses](http://www.seic-loughborough.com/shortcourses)

The NECTISE project holds its second conference, "Realising Network Enabled Capability", in Leeds, 13th-14th October, 2008. This conference will focus on the systems engineering and systems of systems engineering that is crucial to NEC success. The submission deadline for papers is 2nd May 2008. For further information, visit: [www.seic-loughborough.com/nectise](http://www.seic-loughborough.com/nectise)

The UK's Centre of Excellence in Metrology for Micro and Nano Technology (CEMMNT), in collaboration with the Patent-DfMM project and the SEIC, held a one-day workshop in December 2007 at the SEIC, to introduce designers utilising MNT to systems engineering, its benefits, and the techniques that underpin this discipline. The event focused on methodologies, processes and systems engineering based tools, as applied to the design, integration and evolution of products embedding MNT.

A varied and engaging agenda informed delegates from academia and industry of predicted future trends for MNT and more specifically how system-wide simulation and modelling techniques are being increasingly used to identify optimal designs for manufacturing, assembly, packaging and test parameters across the entire lifecycle of MNT products and systems. Exploiting such techniques enables companies to predict failure before it happens, improve quality and performance, generate knowledge of the process and deliver products to market effectively.

For more detail, see the news and events section on the CEMMNT website: [www.cemmnt.co.uk](http://www.cemmnt.co.uk)

## Santa Fun Run

Two of the thousand people who ran 6k dressed as Santa (complete with beards) in the annual Santa Fun Run were members of the SEIC. Together they raised over £200 for LOROS, the local hospice – that deserved a post-race mince pie or two, don't you think?!

Finally, the answer to last issue's puzzle - if a 6" long cylindrical hole is drilled through the centre of a sphere, what is the volume remaining? –  $36\pi$ .

## SEIC welcomes new head

Phil Greenway has been appointed the new Management Head of the SEIC. Phil joined BAE Systems (then British Aerospace) in 1986, after a brief but interesting career in the universities of Oxford, Bath, and Bristol, when his wife (and bank manager) suggested it was time he stopped living on short term contracts and settled down. His first degree is in physics and his research training is in radio astronomy, both of which have stood him in good stead over the years. Along the way he has also picked up degrees in maths and history from the OU, and built his own house, which suggests he had a little too much time on his hands. For seven very enjoyable years he was the Head of the Advanced Information Processing Department within the ATC, getting involved in a wide range of research activities from decentralised data fusion through autonomous systems to Network Sensing. A particular highlight was the Organic Air Vehicle project for DARPA: not only was he able to work with a remarkable team who completed a project rated as "outstanding" by the customer, he had the

good fortune not to be present when the same customer decided to test the team's collision avoidance system by standing in the way of the test robot. He has enough grey hair and doesn't want any more. However, since he has two young children this is probably a vain hope. More recently, he was the Chief Technologist for the ATC, which meant he contributed to developing the strategy for technology acquisition, undertook some memorable design reviews, and helped define and manage the technical research programme within the centrally funded Integrated Capability and Technology Programme. Finally, he has worked with many university partners throughout his career, and has been closely involved in the efforts to innovate systems engineering within the company for nearly two decades.

The SEIC would like to thank Phil Darbyshire for his diligent and supportive six month term as acting head.

## FUTURE ISSUES

- Tactical datalink modelling
- EFAS

## FEEDBACK

Please email your feedback, news and views to [seic@lboro.ac.uk](mailto:seic@lboro.ac.uk). Edited by Ayman El-Fataty and Amanda Pearce. Copyright SEIC\*. All Rights reserved. Winter 2008

