

## Integrated Wing takes off



The Integrated Wing programme sets out to challenge and improve all aspects of wing design and technology integration in a drive to meet environmental, performance and economic targets for all aircraft.

**The Integrated Wing Technology Validation Programme (IWATVP) is a UK national collaboration designed to pave the way for a step change in wing technologies and configurations, addressing the Advisor Council for Aeronautic Research in Europe (ACARE) 2020 'Challenge of the Environment'. The main goals of the challenge address issues such as development, production and maintenance costs, reduced fuel burn, emissions and noise (Figure 1). The IWATVP is one of the pilot Aerospace Technology Validation Programmes (ATVPs) that were proposed by the Aerospace Innovation & Growth Team (AeIGT) and forms a key element of the National Aerospace Technology Strategy (NATS).**

Phase 1 (£34 million) brings together 17 leading UK organisations with the objective of integrating and validating the most promising combination of technologies related to development of wings, wing systems, landing gear and fuel systems. After completing Phase 1, the intention is to go on and develop a large-scale physical demonstrator in Phase 2 of the programme.

– Fuel burn and CO <sub>2</sub> formation (per passenger-kilometre)	50%
– NO <sub>x</sub> (relative to CAEP/2)	80%
– Noise	50%

To make substantial progress in reducing the environmental impact of the manufacture, maintenance and disposal of aircraft and related products

Figure 1: ACARE 2020 reduction targets

The UK has established itself as a centre of excellence for wing design and manufacture, particularly for the Airbus family, creating the most innovative solutions contributing to the twin goals of efficiency and high performance.

As a major validation programme, Integrated Wing also demonstrates the UK's commitment to its responsibilities in meeting the challenges of Sustainable Aviation and is also an important

step in preparing the UK for full participation in the next round of European public research funding – Framework Programme 7 (2007-2013).

The IWATVP will pull through basic and applied research carried out in recent years and ongoing today under UK, EU and privately-funded programmes, and ultimately apply the best solutions to the end product. Its work will incorporate the key UK strengths: wings, wing systems, landing gear and fuel systems – areas which can all make a significant contribution to meeting the environmental challenges for aviation – and bring together advanced technology applications which will be evaluated for integration and validation, including:

- Aero-elastic tailoring, flow control, noise reduction
- New materials and design and manufacturing
- Fuel systems
- Advanced materials for landing gear with noise reduction
- Power plant



## SEIC involvement

The SEIC is involved in two key areas of the IWATVP: Work Package Integration (WPI), consisting of Systems Level Validation and Technology Optimisation, and WP3, which gives a more technological focus to the development of Fuel Systems (Figure 2).

Work Package Integration will provide the mechanism for tying the programme's vertical work packages (WP 1-5) and associated technologies, from the system level assessment into a complex system framework. The framework will be used to identify and quantify the benefits of promising enabling technologies which warrant focused future technology investment in line with ACARE targets, market drivers and direct operating costs.

The SEIC is playing a key role in the development of this framework by applying a Systems Engineering approach to wing engineering that will provide new insights into common requirements, interfaces, interactions, optimal allocation of functions and emergent properties. The systems engineering approaches/tools and techniques will facilitate the development of scalable methods for integrating advanced technologies delivered from WPs 1-5 and provide visualisation at various levels of abstraction, from component level through to the integrated wing, platform, and ultimately (but not within IWATVP phase 1) to the level of the global air transportation system.

By aiding the recognition of opportunities, risks, and the impact of change at the earliest possible stage in the product lifecycle, WPI will result in a better understanding of IW capability and integration requirements, risk mitigation opportunities, the impact of change, and emergence. The success of WPI relies on the close working relationship between SEIC and QinetiQ.

The Fuel System is a critical element of an aircraft and consequently has wide ranging design implications. Apart from supplying fuel to the

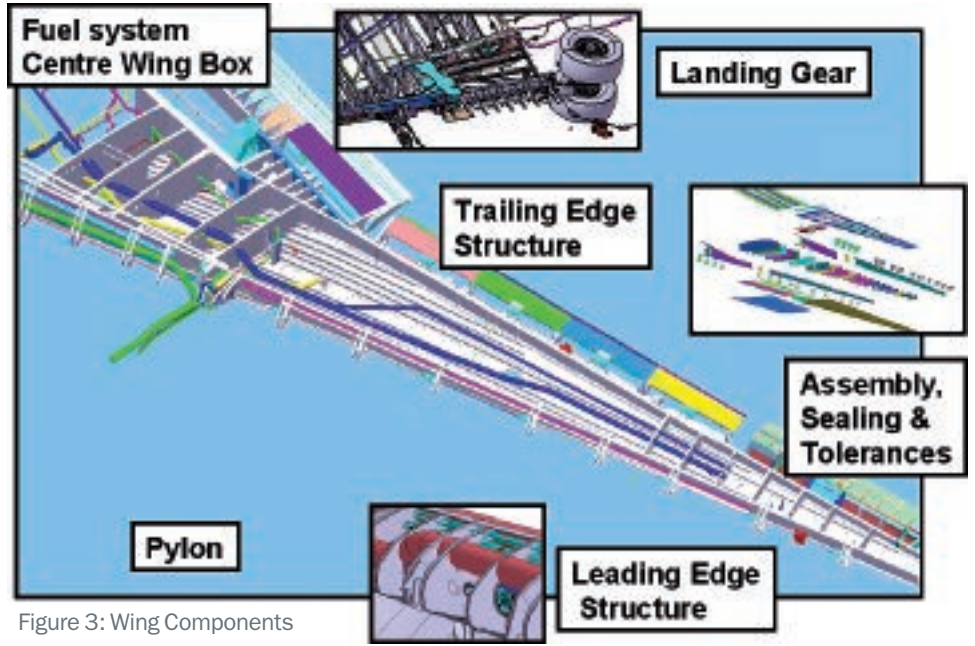


Figure 3: Wing Components

engines, it also provides cooling, stability and load alleviation to the aircraft all of which need to be managed and optimised at an aircraft level.

**... a large degree of testing and modelling will support all aspects of the programme to validate new approaches and novel techniques.**

WP3 will focus on the needs and requirements of aircraft fuel systems and the advances in technology required to meet future regulation.

This will concentrate in the areas of:

- Exploitation of new fuels and additives (including contaminants)
- Optimised use of sensor technologies
- Controlling electrostatic discharge in composite materials
- Improved Fault Diagnostics

It is anticipated that a large degree of testing and modelling will support all aspects of the programme. Consequently experimental rigs at Airbus, the SEIC and the ATC will be used to test and validate new approaches and novel techniques.

By addressing these key areas, any technological advances will be de-risked and will potentially lead to overall aircraft performance improvements through weight reduction and aircraft efficiency savings. This will ultimately strengthen the market position for those partners involved in the consortium.

The SEIC's involvement in this work package will focus upon system level diagnostics in future aircraft fuel systems, leading to reduced operational interrupts. This WP will aim to exploit common technologies across the integrated wing and to share technical data to ensure system level compliance is enhanced at aircraft level. The key to this approach is to understand how the optimisation of the fuel system impacts upon the complete aircraft. These interdependencies will be managed and communicated within Work Package Integration.

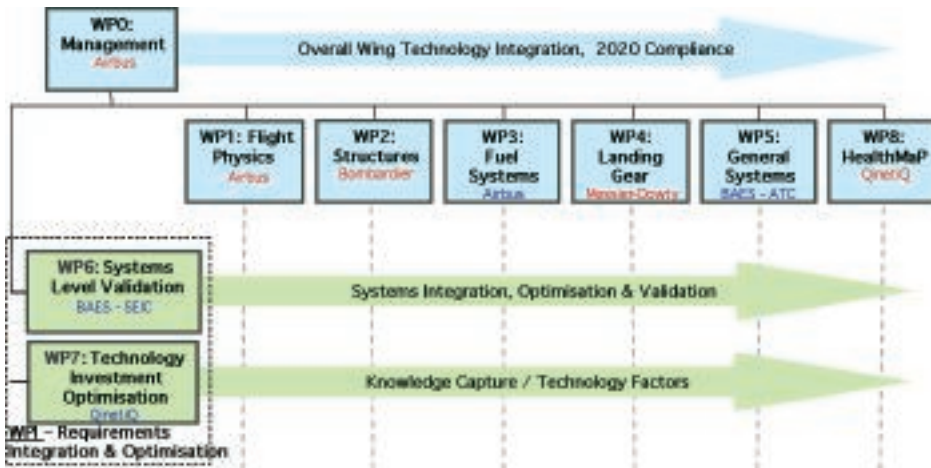


Figure 2: A simplified IWATVP schematic showing the relation between Work Packages

For further information on WPI, contact Dr Peter Bolton (p.bolton@lboro.ac.uk)

For further information on WP3, contact Dr Tony Martin (t.martin2@lboro.ac.uk)

# Getting stuck in!

The Part C projects are one of the highlights of the MEng programme in Systems Engineering at Loughborough University.

**“... the standard of the presentations was high and the project areas covered, both broad and relevant to the current industry needs. This is an excellent reflection of the university and its connection to industry through the SEIC”.**

*Graeme Marriott, Systems Engineering Manager  
BAE Systems, Submarines*



**Systems Integrated Land Vehicle:** The development of a vehicle capable of interaction with other systems in the SEIC's 'system of systems' project.



**A Synthetic Design Environment For Systems Engineering:** Development of a PC based immersive workbench which presents interactive monoscopic or stereoscopic visual representation of datasets.



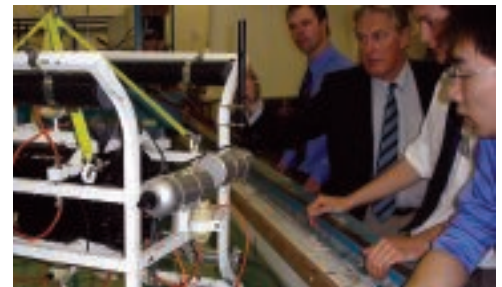
**Autonomous/Remotely Operated Hovercraft:** Production of a small craft capable of being controlled remotely or programmed to carry out a specific task gave this project a strong mechanical flavour.



**A System For Virtual Clinical Trials Of Inhaler Devices:** This project used the Varidose sensor device and a breathing simulator to identify the type and variability of inspiration profiles of specific patient groups with the aim of improving accuracy and effectiveness of an inhaler device.



**Health And Usage Monitoring System (HUMS) for Autonomous Systems:** Fault diagnosis, isolation and prognosis formed the focus of this project using a robot from the SEIC's 'system of systems' demonstrator suite.



**Autonomous Underwater Vehicle:** Design and integration of all the systems to produce a working prototype vehicle. Already complete with multiple thrusters, drive system, sonar, magnetic compass, accelerometers and powered by batteries to allow a mission of up to two hours, the increased capability included a datalink, a navigation sub-system and mission definition and analysis software.

Group projects are always technically sophisticated, challenging and fascinating. Presentations and demonstrations are made in early May and are open to friends and associates from interested companies.

If you would like to be invited to the 2007 project day, or would like to know more about the programme, please contact the Programme Director, John Hooper: ([j.g.hooper@lboro.ac.uk](mailto:j.g.hooper@lboro.ac.uk))

## Business Update

The past few months have seen a number of events held at the SEIC to cater for the needs of businesses of all sizes.

We hosted the INCOSE Midlands Group 'The future of systems integration' event at which IBM, National Instruments, Mathworks, Artisan, Telelogic and BIW Technologies were able to both exhibit their current technology and provide their respective views on control system modelling and real time control, architectural systems modelling, requirements engineering and business process planning.

The keynote speech was delivered by Steve Whittle of the SEIC on 'The future of systems

integration – practitioner or vendor driven?' The event concluded with a panel discussion involving all those who had presented during the day.

The INCOSE Midlands Group held a meeting to discuss the development of a Unified Modelling Language (UML) Practitioners group in early August. UML and SysML are emerging approaches to aid in the visualisation and definition of systems.

A further event is scheduled for October on the interoperability of systems within the organisation and its supply chain and how this has a direct effect on business capability. The flexibility of such systems is a necessary future requirement for businesses wishing to adapt to rapidly changing marketplaces.

Other events tailored for smaller enterprises have been held on themes of business expense reduction, training in the use of E-Bay for marketing, and technology 'spin out' and 'spin in' in partnership with the Defence Diversification Agency.

We are currently developing an event for cost estimation for smaller enterprises.

We would be interested in hearing from anyone who would like to contribute to or attend future events on the themes mentioned above or on other themes of interest.

Please contact Ken Astley  
01509 635208  
e-mail: [k.r.astley@lboro.ac.uk](mailto:k.r.astley@lboro.ac.uk)

# In the news

The SEIC hosted a visit by Dr Dai Morris, the UK MOD Director for Analysis Experimentation and Simulation (DAES). The visit provided the SEIC with a valuable opportunity to showcase the combined capabilities of Loughborough University and BAE Systems at the SEIC. In his own words, Dr Morris noted that "the clear utilisation of both academic and industrial expertise gives us the scope to encourage truly innovative research, and I am sure that there are areas where I should look more carefully with our RAO at how we can work together to develop the 'state of the art' using some of the pressing research issues facing DAES at present".

The SEIC also met up with senior representatives from the Future Carrier (CVF) Team, based at Frimley. The meeting held at the SEIC focused on reviewing how systems engineering for the Royal Navy's new aircraft – which is heavily reliant on the use of the Department of Defence Architecture Framework (DoDAF) – is being undertaken on this programme.

Ayman El-Fatraty chaired a workshop in London to help identify the key priority areas of research relating to systems engineering which the UK industry must develop in order to sustain its future

competitive advantage and capabilities and implement NATS. The workshop, championed by SBAC attracted representatives from Thales, Bombardier, Smiths Aerospace, Goodrich, Rolls Royce, MBDA, the DTI, BAE Systems, the RDAs and the MAA. Excellent progress was made in advancing the Systems Engineering AIN strategy.

David Martin (Deputy Chief Engineer) from the Culham Science Centre visited the SEIC June to discuss collaborative outreach partnership. Opportunities for training, student exchange, shadowing and potential partnerships were all identified.

## INCOSE 2006

The SEIC presented two papers at the INCOSE 2006 symposium in Orlando:

David Battersby's paper was entitled, 'Architecting Synthetic Environments to Support the Systems Engineering of Capability' – a paper looking at how architecture frameworks can support the improved use of modelling and simulation in modern systems engineering.

Eshan Rajabally presented a paper on 'Fuzzy decision support for determining the fitness-for-purpose of systems modelling and simulation.'

Both papers can be found in full via the SEIC website ([www.seic-loughborough.com](http://www.seic-loughborough.com))

Dr Andrew Bradley, Chairman of BAE Systems' Systems Engineering Council and a member of the SEIC Strategy Group, also participated alongside Tom Wells of Harris Corporation in a panel on "How Industry Tailors University Programs to Satisfy Needs" as part of the Academic Forum.

Ricardo Valerdi made a presentation to Insyte and other BAE Systems' business units at the SEIC of the COSYSMO estimating tool prior to its trialling.

A workshop on the integration of modelling tools is being planned for November.

If you or your company are interested in getting involved or would like any more information on any of these topics, contact Ayman El-Fatraty, Customer Manager, ([a.el-fatraty@lboro.ac.uk](mailto:a.el-fatraty@lboro.ac.uk))

## A tribute to Peter Haysman



It is with great sadness that the system reports the passing of Professor Peter Haysman, who died at home on 18th June 2006 after a long illness.

Peter was one of the driving spirits for the SEIC, and was

responsible for bringing together the business units of BAE Systems to define the early research themes through his leadership of the Systems Engineering Council's "Research & Technology" subgroup between 2000 – 2004.

Peter's promotion of Systems Engineering – introducing some of the techniques and training engineers in systems thinking – started long before it became fashionable. Today's "Systems Engineering Short Course", completed by over 1000 BAE Systems employees, is a direct descendant of the one he established for Royal Ordnance in the mid 1990s.

In recognition of his ability and extensive experience, Peter was appointed Visiting Professor of Systems Engineering by Loughborough University in March 2004, shortly before his retirement from BAE Systems. Sadly, he became ill only a few months later and never got the chance to share his knowledge with a new generation of systems engineers.

A great intellect, Peter was able to express the most complex problems in the simplest ways, but without making other people feel small. That said, he had high ideals and knew what he wanted to achieve – which didn't always make him the easiest person to please! Always courteous, but very 'down to earth' and with a wonderfully dry sense of humour, Peter was a delight to work with.

He is sorely missed by friends and colleagues, and a great loss to systems engineering.

## Counting Systems

Chris Rand, Editor of Engineeringtalk, The Independent Weekly Product Information Guide for Product Design and Automation Engineers, writes:

.... according to the latest Oxford dictionary, the word "time" is the most common noun in the English language... I wonder if that's the same in the engineering world? Where better to look than our own archive of news, which now contains over 12 million words, in 39,444 news releases from 3,833 different suppliers.

And from the 216,000 different words which appear, what is the most common noun in the world of engineering (or at least the world of engineering marketing)? By a considerable margin, it's "system" or "systems", and in clear second place, "product" or "products". Making up the places are "range", "control", "applications" and "design", although some of those are also being used as verbs, I'm sure.

"System" or "systems" appears nearly 67,000 times in the (nearly) 40,000 press releases on Engineeringtalk; in fact, the word appears in just over half of the news releases, but in fewer than the runner-up word, "product", which implies that when manufacturers use the word "system", they do it with a vengeance.

To receive the email newsletter from Engineeringtalk, send a blank email to: [join-eng-talk@news.pro-talk.com](mailto:join-eng-talk@news.pro-talk.com) or log on to <http://www.engineeringtalk.com/>

### FEEDBACK

Please email your feedback, news and views to [seic@lboro.ac.uk](mailto:seic@lboro.ac.uk). Edited by Ayman El-Fatraty and Amanda Pearce. Copyright SEIC\*. All Rights reserved. Summer 2006

### FUTURE ISSUES

– Day/Night All Weather Integrity Study  
– Integrating academia and industry