

Engineering Doctorate in Systems

a doctoral training programme for strategic leadership.

Engineers today face critical challenges associated with design and operation of increasingly complex and interdependent systems. Addressing these multifaceted issues and preparing for the future requires exceptional people with strong strategic capability.

The Engineering Doctorate (EngD) in Systems equips candidates - and thereby their organisations - with the skillset to meet these challenges. Using a holistic approach to research, teaching and training, the EngD in Systems combines technological innovation with development of engineering programme management and leadership skills to produce influential industry frontrunners -people who accelerate their organisations to the next stage.

Currently more than 45 companies are involved in sponsoring and collaborating with researchers in the Systems Centre. Research being pursued ranges across global markets, including **transport, energy, aerospace, the built environment, IT, security, defence, finance, smart infrastructure and manufacturing.**

Industry mission in the 21st Century*

- Approaching new problems with fresh minds
- Responding to changing demands
- Continuously seeking new challenges across marketplaces
- Looking beyond the engineering to see the bigger picture
- Streamlining operations and lifting productivity
- Collaborating in innovation
- Making a positive difference in the world
- Sharing knowledge to solve difficult challenges

EngD in Systems delivers

- Strategic leadership
- Deep specialist engineering knowledge
- Collaborative working
- Holistic approach encompassing technical, social, economic and ecosystems
- Cross-industry learning
- Capability to develop next-generation of efficient, sustainable systems
- Efficiency to achieve more from less
- Access to cutting-edge facilities and world-class expertise

*from analysis of industrial partners' websites



Fig 1 - EngD in Systems is adding value

Key people at the Systems Centre:



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University of Bristol**

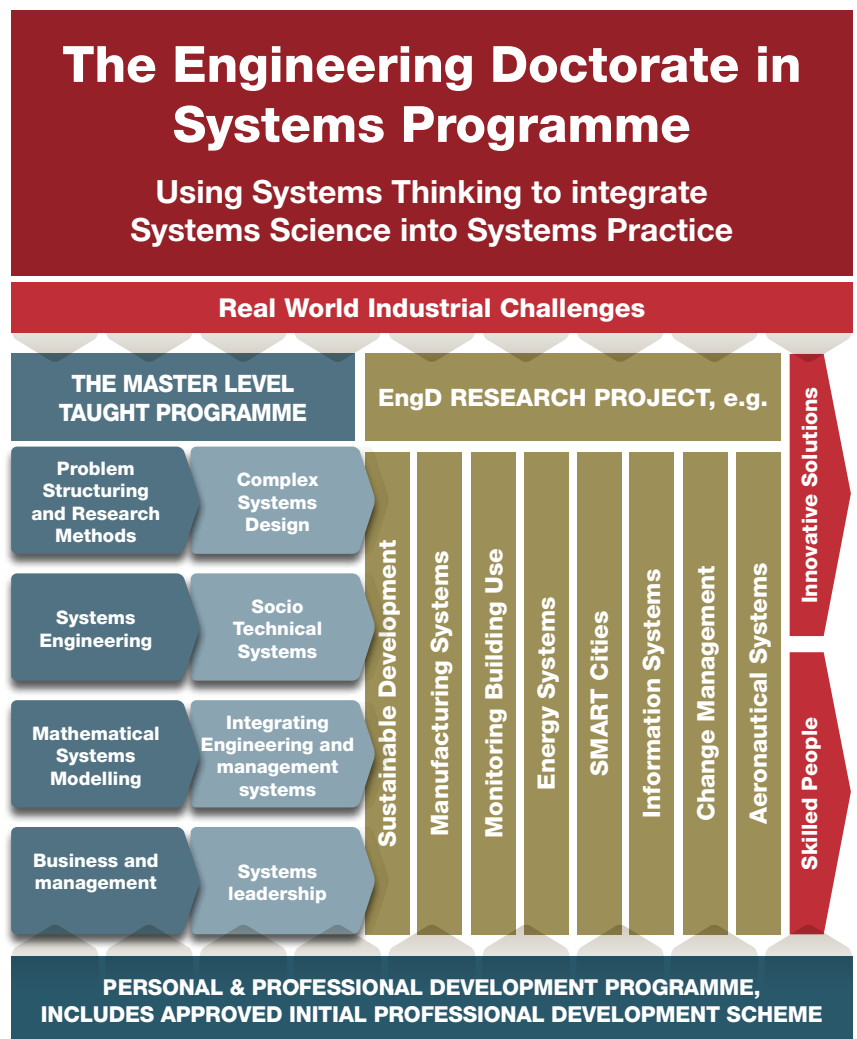
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What makes EngD different?

- EngD research is driven by industry need
- EngD enables industry partners' R&D
- Researchers work within industry and research is co-supervised through academia and industry
- The output of sponsored research is owned by partner organisations
- EngD adds immediate value to industry (refer to figure 1)

The EngD in Systems Programme is made up of three core elements as shown in Figure 2. Sponsored candidates have access to high-quality research-led teaching and skills training. This includes taught Masters level units in advanced technical and professional skills relevant to the needs of industry.

Fig 2 - EngD in Systems structure



EngD experience counts towards CEng



The EngD in Systems is an Engineering Council accredited programme (IMechE, ICE and IET) allowing high-calibre engineers to achieve both a Doctoral Degree and chartered status while simultaneously developing the solutions to the real industrial research problems in sponsoring organisations.

Specific case studies can be found on the dedicated flyer. For cost models please contact us.

EngD in Systems Industrial Impact

Airbus is the world's leading aircraft manufacturer whose customer focus, commercial know-how, technological leadership and manufacturing efficiency have propelled it to the forefront of the industry. Across all its fly-by-wire aircraft families Airbus' unique approach ensures that aircraft share the highest possible degree of commonality in airframes, on-board systems, cockpits and handling characteristics, which reduces significantly operating costs for airlines.



Ian Marr - EngD impact: improved strategic decision making for resilience



The great complexity of Air Transport Systems means that in current conceptual aircraft design processes it is extremely difficult to understand the full implications of any given design decision, and to anticipate net value of any proposed product or service before significant development, testing, or usage, has taken place. Besides the well-known technical complexity, much of this intricacy comes from the behavioural characteristics of Air Transport System stakeholders - their interdependencies and interactions, and their individual adaptation to their evolving environment. Ian's research focuses on how strategic decision-makers in the Air Transport System adapt to their dynamic environment, and how they pre-empt possible future changes to their environment to remain robust and resilient to likely disruptions.

Yifan Xie - EngD impact: 50% reduction in information search time



"Under the EngD research programme, Yifan worked with Airbus Wing In-Service Support to improve our capability to capture and learn from In-Service repair experience. By integrating advanced information technology with the existing toolset, Yifan developed an intelligent search engine for previous repair cases.

Thanks to Yifan's research work, the time that Airbus UK repair engineers spend in searching for information is reduced by more than 50%, and our capability for handling customer enquiries (on time and on quality) is greatly increased without the need for additional personnel. This search tool is now deployed in Germany, UK and US for use in the daily repair engineering task, and is in the process of being rolled out to other locations in Airbus."

Andrew Dunn, Head of Engineering, Customer Services, Wing at Airbus

Christian Agostinelli - EngD impact: 20-80% time saving on standard wing design process

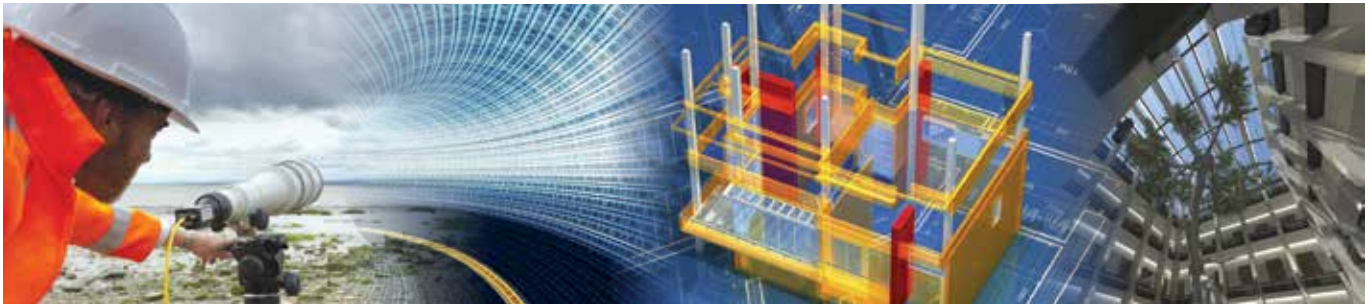


"Christian's research within the tools and simulations team for Flight Engineering Sciences department focused on rapid methods for aerodynamic wing design. During his four year EngD program he has developed methods and processes that combine and exploit the state of the art the technology for solving multidisciplinary challenges that he has identified.

The methods and processes aim to save between 20-80% of the time on tasks performed during a standard design process"

Abdul Rampurawala, Flight Physics Engineer, Airbus





ARUP is an independent firm of designers, planners, engineers, consultants, and technical specialists offering a broad range of professional services.

“The EngD [Smart Cities – governance and implications for city councils] has already tangibly improved our consulting capability and has directly influenced policy decisions for smart cities in the UK and internationally”

Volker Buscher - Director of Technology Innovation, ARUP (2013)



Parsons Brinkerhoff has over 15000 staff and is one of the foremost infrastructure consultants worldwide, and as the professional service arm of Balfour Beatty they are part of one of the world's leading global infrastructure businesses.

“For us one of the most exciting features of the EngD in Systems is the way in which your approach can be brought to new and challenging issues for the infrastructure sector.”

Steve Denton - Engineering Director, Parsons Brinkerhoff (2013)



Frazer-Nash is a multi-disciplinary engineering consultancy that excels at solving some of today's most complex challenges in engineering.

“Our investment to date in the Systems Centre has made a positive impact on our business in terms of supporting the development of new services, enabling the recruitment of leading systems thinkers, providing network opportunity across the international systems community, and contributing to the decision to form a new technical area within our business.”

Edward Goddard, Consultant, Frazer-Nash (2013)



Halcrow is now a CH2M HILL company and thus part of a world leading infrastructure consultancy. It specialises in water, energy, environment, transportation, natural resources, and facilities.

“We have sponsored four EngD Projects and the current EngD research is addressing very challenging socio technical problems: ‘Sustainability of large scale infrastructure projects’ and ‘Benefits of non-structural flood risk management responses’. These directly benefit our business and the businesses of our clients and have led to EngD graduates joining our company.”

Jon Wicks - Regional Technology Manager, CH2M HILL (2013)



Delivering Transformative Change in Industry

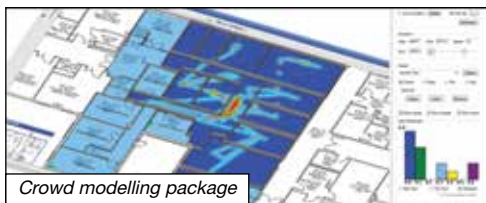
“Buro Happold is an integrated engineering consultancy working on leading built environment projects around the world. One of our defining features is a commitment to research and development and we are proud to have a long association with Bristol Systems Centre where we have sponsored EngD students from the Centre’s early days. We currently have 4 research engineers (REs) with the centre and at least as many that are alumni. Given the nature of our business the research topics are varied and range from decentralised water systems through post-occupancy analysis of buildings to computational optimisation and crowd flow software development.

All our REs engage in real life projects whilst working in Buro Happold and this gives them a deep understanding of how we work and the network on which to transfer their knowledge within the company. Almost all are employed at the end of their research and are soon in positions where they are given early responsibility and the opportunity to develop their core technical skills within a specialist group”.

Colin McCinnon, Innovation Director, Buro Happold, 2013

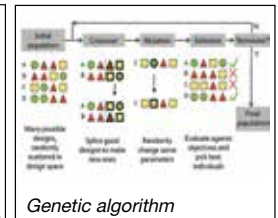
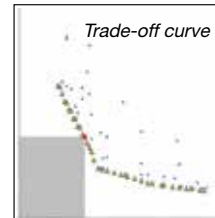
EngD in Systems Research Projects - Buro Happold

Dr David Greenwood - Next generation crowd flow simulation and visualisation



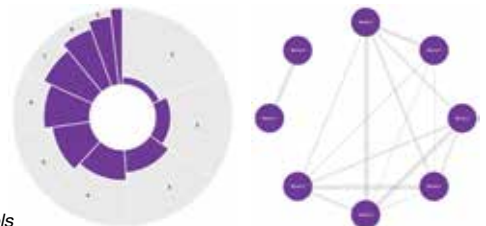
David leads the SMART team’s crowd simulation and data analysis innovation project. Contributions so far have been to develop a novel approach to simulating crowds composed of 100,000s of interacting people, and to extend the data analysis suite to enable the analysis of LPS (local positioning system) data. These have contributed to a Makah modelling project and an NHS hospital neo-natal ward.

Dr Ralph Evins - Multi-Objective Optimisation as an Aid to Design Space Exploration for Low-Carbon Buildings



Ralph is applying multi-objective computational optimisation techniques to a range of sustainable building design problems. Optimisation is a process which is highly dependent on context and system boundaries. A holistic approach to phrasing the problem is essential.

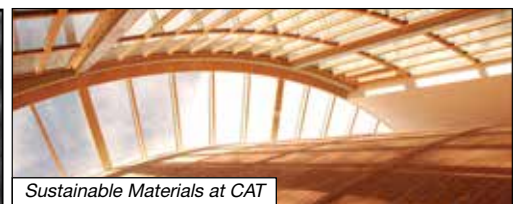
Phil Hampshire - Selecting systems and materials for using in roof construction to reduce the environmental impact of buildings



Decision support tools

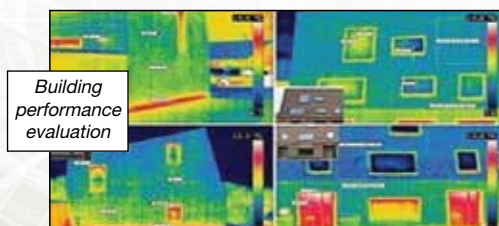
Phil has a strong interest in Sustainable Development and using systems approaches to address the social as well as technical aspects of complex problems. The emphasis of Phil’s research is on improving decision making with respect to roof design and selection to deliver increasingly sustainable buildings.

Natasha Watson - Sustainability of buildings – development knowledge and guidance for increased deployment of natural materials



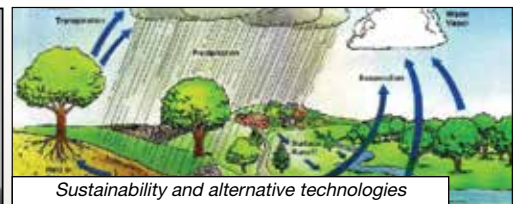
Natasha’s research looks at increasing the use of low impact building materials in the U.K. This includes barriers to adoption, potential solutions, Life Cycle Assessment, and investigating case studies to identify high impact areas. The outcome will be a material decision support tool whereby structural and facade materials can be chosen on environmental, social, and economic grounds.

Dr Zack Gill - Building Performance Evaluation of Aspiring Low Carbon and Low Energy Domestic Buildings and the Impact of Occupant Behaviours:



Zack’s EngD looked at the impact of occupant behaviour on the real-life performance of aspiring low energy/carbon buildings in the UK. He developed a survey tool and interview structure to capture information on domestic occupant behaviours, which can explain a proportion of performance variation. The methods and process allowed unprecedented access and insight into behaviours and explained between 7 – 48% of the variation in utility consumption between otherwise comparable dwellings.

Dr Celia Way - The Application of Decentralised Water Systems in the UK: What Constitutes Better Water Systems for the UK Context



Celia’s research investigated the debate around what scale of water system is ‘better’ in the UK context. She explored the benefits and drawbacks of decentralised and small scale approaches such as rainwater harvesting to complement the traditional ‘mains’ supply. She identified that with these additional systems comes additional impacts; environmental, technical and social, which are not necessarily negated by the effect of drawing less water from the existing infrastructure. Her EngD therefore considered the balance of these impacts to determine which strategy is ‘better’.



"As industrial sponsors, we find the Engineering Doctorate the most cost-effective model for achieving our combined research and specialist postgraduate recruitment requirements. In addition, in our work with the Bristol Systems Centre we have got particular value from aligning the work of several of our sponsored EngDs under an umbrella project which is part of our strategic process improvement activity. In this way the EngDs are able to provide considerable value to Thales during the period of their studies, meet a wide spectrum of people at all levels in the company, and they and their supervisors get access to real world data (both quantitative and qualitative) across a portfolio of several hundred projects." *Prof Hillary Sillitto, Systems Engineering Director, Thales UK, 2013.*

THALES

EngD in Systems Research Projects - Thales UK

Duncan Tait - An integration architecture for communication systems network modelling.



The purpose of this research is to apply the principles of communication network simulation to radio networks deployed and integrated by Thales, whilst investigating complex behaviour exhibited by these, and large-scale radio networks in general. The capability to simulate radio networks forms part of a developing framework that aims to produce a broad analysis of radio systems that will be useful in aiding decision making at any stage of a product or bid lifecycle.

Dawn Gilbert - Prediction of final cost and duration from Systems Engineering Metrics.



This project examines the role of metrics to gather earlier indications of whether expectations of project cost and schedule will be met. The focus is on the socio-technical boundary, examining technical aspects of the projects, and social aspects relating to project staff composition, capability, and the working environment. This work extends recent research on how to measure systems thinking and systems engineering capability, and the impact that capability levels have on Systems Engineering actual project cost and duration, relative to budget.

Jim Stamp - The use of cybernetic and complex adaptive systems theory to optimise engineering practices and procedures.



With the increasing complexity of our projects and markets it is important that we optimise our processes to achieve the best results. We aim to show, using a cybernetics-inspired agent-based-model, that it is important to select the correct processes for an operating environment. This work is supported by a study into the correlations between communication network archetypes and market complexity, a case study within a complex project and a survey of engineers regarding their views of process, creativity and complexity.

Tristan Butterfield - Improving complex project delivery: investigation and development of parametric estimation methods.



History shows that Thales can successfully develop and deliver complex systems. However cost overruns occur and accounting for them is inconsistently applied across the Thales business. Holistic approaches to complexity and metrics based parametric estimation are poorly understood across UK industry in general. The research will explore questions that will help Thales establish an accurate parametric estimation method and will include an investigation into whether an optimised set of systems and software engineering metrics can provide the required data to achieve this.



Tom Walworth - Addressing the Socio-Technical Issues Surrounding the Use of Technical Performance Metrics.

The technical performance of a project may be obscured by the use of conventional project management metrics which often don't include measures of technical progress. Technical shortfall is characterised by late awareness of problems. Additionally it can be seen that large hierarchically structured firms struggle to achieve the change required for the introduction of new tools, techniques and process. My project therefore focuses on the socio-technical issues related to embedding a set of technical progress metrics that allow better control of projects.