



The Royal Academy
of Engineering

A Philosophy of Engineering Seminar:
**Systems Engineering and
Engineering Design**

29 Great Peter Street
London SW1P 3LW

Monday 26 March 2007
2.00 pm – 7.00pm



Systems Engineering and Engineering Design

This is the second in a series of public seminars on the philosophy of engineering run by The Royal Academy of Engineering. The series aims to explore philosophical issues that arise in engineering research and practice. This seminar will explore some of the concepts central, and perhaps unique, to engineering practice: engineering design and systems engineering. It will investigate the nature of design, what counts as good design, the challenges of designing complex systems and the place of people in engineering systems.

Future seminars will be held on the following topics: AI and IT - where philosophy and engineering meet; metaphysics and engineering; engineering and environmental philosophy; education and the philosophy of engineering.

John N. Turnbull FEng

John Turnbull graduated in Chemical Engineering in 1961 and joined BP. His early career was in Process Development and Design. He was subsequently involved in Production Management. Later responsibilities included Business Management and the Direction of Technology, Engineering, Health, Safety and Environmental policy for BP's Chemicals activities. After retiring from BP in 1993 as Deputy CEO of the then BP Chemicals he engaged in General Management consultancy and the direction of an international Senior Executive Development programme for the Wharton Business School at the University of Pennsylvania.

The Context and Nature of Engineering Design: While engineers engage in a wide range of activities it is design that lies at the core of the discipline. Technology development and application are driven by the demands of engineering design. By reviewing the context and nature of engineering design we discover that engineering is primarily a social rather than technological discipline. Good engineering is defined, not just by whether or not it works, but also by the cultural and social mores of the community it seeks to serve. Engineering must take these into account. But equally, engineering should also inform and influence societal attitudes and values.

Professor David Andrews FEng

David Andrews was given a new chair in Engineering Design at University College London in 2000 following a career of over 30 years in the Ministry of Defence in naval ship and submarine design and acquisition. He was the Project Manager for the Replacement Amphibious Fleet, Head of Preliminary Design and, finally, Director Surface Ships. In two earlier academic secondments to UCL he developed a new approach to computer aided

preliminary ship design. His current research team at UCL is focused on exploiting this approach across a wide range of applications, including novel ship types, design for production and integrating simulation techniques into initial design. He also edits the Design Methodology State of Art Reports to the triennial International Marine Design Conference.

Philosophical Issues in the Practice of Engineering Design: Engineering design not only serves to distinguish engineering practice from scientific endeavour but is also a distinctly different mode of operating, when compared with other aspects of the engineering discipline. Design, it is held, can be regarded as different in character from other activities in the field of engineering. There are seen to be philosophical issues associated with the practice of engineering design raised by developments in design synthesis, design management, functionalism, optimisation, computer aided design, simulation based design and virtual reality. The need for a coherent debate in evolving a rational understanding of engineering design is considered to be part of the underlying agenda for achieving a more philosophical underpinning to engineering practice.

Professor Maarten Franssen

Maarten Franssen is associate professor at the section of Philosophy from Delft University of Technology. He studied theoretical physics and history and received a PhD in philosophy from the University of Amsterdam on a study of the foundations of the social sciences. His research interests include the application and integration of social-scientific and philosophical approaches and theories in engineering design and the engineering sciences.

Roles and rules and the modelling of socio-technical systems: What primarily distinguishes socio-technical systems - such as the road transport, air transport and electric energy systems - from traditional engineering systems is that they consist not only of 'purely technical' hardware elements, but also of people. This gives rise to a multitude of conceptual difficulties and causes difficulties for the designers of such systems. Traditional modelling techniques use mathematico-physical descriptions, in which the human element is either pressed into the mould of such descriptions or swept into the boundary conditions and the environment. In socio-technical systems, the human element is too diverse and too ubiquitous to be represented in this way. This presentation will discuss examples that illustrate the above points and present some ideas on what theories from the social sciences can and cannot contribute to the problem of modelling and designing socio-technical systems.

Dr Chris Elliott FREng

Chris Elliott is a system engineer and barrister, bringing together a combination of technical and legal insights to the boundary where science and technology meet the law. His practice revolves around the commercial exploitation of technology in the public sector and regulated industry, including transport, chemicals, energy and the environmental and medical sectors, as well as more general issues in science and technology policy.

Engineering as synthesis - doing right things and doing things right: Engineering is still largely taught and studied as a set of disciplines, each tucked safely in its intellectual comfort zone. Few people are 'engineers'; they are 'civil engineers' or 'electrical engineers' or 'mechanical engineers'. But the real world and the materials and technologies with which engineers work do not respect those artificial silo walls. Real engineering means solving problems and the problems overspill not only the walls of the engineering disciplines but also into psychology, finance and sociology, to pick just three of the many fields that contribute to success. We need to rethink how we educate and train engineers to equip them to solve the real problems, without losing the precision and rigour that keeps the 'plane in the air or the building on its foundations.

Schedule

- 2.00pm: Registration, tea and coffee
- 2.30pm: **Dr Keith Guy FEng:**
Chair's introduction
- 2.35pm: **Mr John Turnbull FEng:**
The Context and Nature of Engineering Design
- 3.10pm: **Professor David Andrews FEng:**
Philosophical Issues in the Practice of Engineering Design
- 3.45pm: Break for coffee
- 4.10pm: **Professor Maarten Franssen:**
Roles and rules and the modelling of socio-technical systems
- 4.45pm: **Dr Chris Elliott FEng:**
Engineering as synthesis - doing right things and doing things right
- 5.20pm: **Panel discussion**
- 6-7pm: Reception

For further information, please contact Dr Natasha McCarthy at natasha.mccarthy@raeng.org.uk or tel. 020 7227 0575

To register for this event please contact Miss Sylvia Hearn by telephone on 020 7227 0519, by email at sylvia.hearn@raeng.org.uk or by post at:

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The Royal Academy of Engineering

As Britain's national academy for engineering, we bring together the country's most eminent engineers from all disciplines to promote excellence in the science, art and practice of engineering. Our strategic priorities are to enhance the UK's engineering capabilities, to celebrate excellence and inspire the next generation, and to lead debate by guiding informed thinking and influencing public policy.

The Academy's work programmes are driven by three strategic priorities, each of which provides a key contribution to a strong and vibrant engineering sector and to the health and wealth of society.

Enhancing national capabilities

As a priority, we encourage, support and facilitate links between academia and industry. Through targeted national and international programmes, we enhance – and reflect abroad – the UK's performance in the application of science, technology transfer, and the promotion and exploitation of innovation. We support high quality engineering research, encourage an interdisciplinary ethos, facilitate international exchange and provide a means of determining and disseminating best practice. In particular, our activities focus on complex and multidisciplinary areas of rapid development.

Recognising excellence and inspiring the next generation

Excellence breeds excellence. We celebrate engineering excellence and use it to inspire, support and challenge tomorrow's engineering leaders. We focus our initiatives to develop excellence and, through creative and collaborative activity, we demonstrate to the young, and those who influence them, the relevance of engineering to society.

Leading debate

Using the leadership and expertise of our Fellowship, we guide informed thinking, influence public policy making, provide a forum for the mutual exchange of ideas, and pursue effective engagement with society on matters within our competence. The Academy advocates progressive, forward-looking solutions based on impartial advice and quality foundations, and works to enhance appreciation of the positive role of engineering and its contribution to the economic strength of the nation.



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