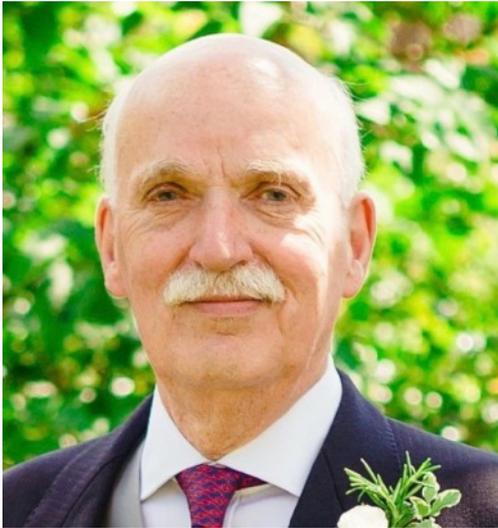


I Am a Systems Engineer and I Do...

Peter Brook



Why did you choose to be a Systems Engineer?

I'm not really sure – it grew on me over a number of years. My first degree was in Physics and I spent 10 years doing research on microwave semiconductor devices for MOD. By my late 20s I was heading a team covering all aspects from crystal growth, device fabrication and subsystem development, while doing the computer modelling. It was all quite applied, but with a strong theoretical underpinning. We were certainly dealing with a type of complexity, but not the sort that was to come.

When we were all moved to Malvern, I made a big career switch to join the Nimrod Airborne Early Warning (AEW) project, which was just under way. I was given responsibility for evaluating system performance and interoperability. The whole project was an object lesson on how *not* to do SE, particularly the lack of up-front work. We did what we could, sifting through and analysing overlapping specifications, and building models and simulations of the system in the wider environment, but the project and contracting model were ill-conceived from the outset.

I had a formative interlude of a few years as Head of Computer Networks Division, where the work included collaboration with the (then) ARPA Internet, then still a research project. Our contributions came in security and resilience. We had one of the first nodes of the Internet outside the US in the basement under my office, and our budget paid the satellite bill to bring the network across the Atlantic! We were also technical authority for the RAF's first digital data network.

I was then put in charge of Air Defence and ATC Group, co-ordinating all research and project advice associated with the UK Air Defence System while it was undergoing the first comprehensive upgrade of its air and ground-based elements since WW11, including introduction of tactical data links. During that time, I also led an independent audit for MOD on the Nimrod Project – still limping on, but by then visibly failing – and cancellation followed a year later. This was an expensive disaster for procurement and the reputation of the UK defence industry generally. Some of the motivation and corporate support for setting up INCOSE UK later on came from not wanting a repeat.

After a spell in Whitehall, where I led technical input to procurement decisions and oversaw operational analysis for Land Systems, and helped to shape customer-based research management, I returned to Malvern to head Battlefield Systems Group, where we applied the whole-systems approach to the new generation of ISTAR projects and a number of strategic and secure systems. (Lots of prototyping and modelling here too, as well as building small-scale systems to meet urgent operational needs.)

With the MOD laboratories going through the transformation which eventually led to QinetiQ and DSTL, I moved over time from senior management to strategic technical roles: Chief Scientist for Land Systems – co-ordinating early work on *Battlespace Digitization* and *Vehicle Systems Integration*, and the *Synthetic Environments* programme - and then Director of Systems Engineering for the whole of DERA.

The last step came as a result of a major thrust to put the SE centre-stage within DERA, MOD and nationally. It's hard to believe we did so much in just a few years: wrote an SE book (still in print) and the first DERA SE processes; one of the authors (Stuart Arnold) used the material to draft the first edition of ISO 15288 and secure international agreement, for which he is rightly remembered in INCOSE; another (Richard Stevens) formed a company to develop and market DOORS which became the world's leading requirements management tool.

I helped to get INCOSE UK off the ground: as one of the 'gang of 6' which met in 1993 to plan its formation (serious illness kept me away from the now-famous first public meeting at Shrivenham). I joined INCOSE even before the UK Chapter was fully formed (membership No 2049!) and was soon elected to the Board of Directors (they were keen to appoint non-US voices, having just put the 'I' in INCOSE), acted as principal author of the DTI Foresight Report (*Building*

Integrated Systems) providing a strategy for UK's national capability in SE, and convinced MOD to put SE at the heart of Smart Procurement. And we sponsored the first MSc and SE Chair at Shrivenham, helped to design the course, and ran the first two symposia.

My proudest moments came in 1999: receiving Fellowship of the Royal Academy of Engineering from the Duke of Edinburgh, and leading the Government Chief Scientist Sir Robert May to the stage to deliver the opening address to the INCOSE International Symposium in Brighton, having helped persuade them to hold it outside the US for the first time.

By this stage I certainly considered myself a Systems Engineer, so when MOD advertised for someone to establish and lead its Integration Authority (IA) in 2000, I took the plunge. The following 5 years were complex, not least in having to build the team, tools and methods in a complex and often sceptical organisation, requiring immediate results and constant reassurance that we would provide a return on (considerable) investment. I look back with some satisfaction at much of what we achieved, especially considering the deep and longstanding nature of the problems and the state of knowledge at the time. Many of the issues we faced then are still there now, though much excellent work has been done to move things along. I became the Head of Profession for SE in DPA.

After the IA, I slowed down a bit. I couldn't maintain the intensity of the previous 10 years, but greatly enjoyed applying my knowledge and experience more widely, mainly in consultancy roles. Before and after retiring from QinetiQ in 2010, I had the privilege of working for National Policing, Defence Academy, Met Office, Nuclear Decommissioning Authority, Home Office, Dept for Transport, Dept for Local Gov't, GCHQ, DARPA (US), EU, Loughborough University and MOD. I also edited a re-write of the QinetiQ SE guidance.

In recent years I have returned to writing papers and giving talks. I have also dipped into and out of INCOSE Groups (Bristol LG and Architecture WG), set up and ran an Enterprise Systems Engineering IG for a while, and have spoken at Training Days, ASECs and International Symposia (Rome and Edinburgh). A special pleasure was being asked in 2015 to participate in writing a NATO lecture series on Systems of Systems delivered in Paris, Lisbon, Sofia and Mannheim, alongside Judith Dahmann (US DoD) and Prof Mike Henshaw of Loughborough, two of the recognised leaders on the subject. That taught me a lot.

I stood aside from deep involvement in INCOSE in 2000, what with the IA and other things, but it's been a real pleasure to see how the leadership and members have so expertly consolidated its position at the core of UK's national engineering professional life.

I now spend more time in other pursuits: singing (Worcester Cathedral Chamber Choir), family (grandfather of 2), Malvern Hills Arts Society, travel, photography, U3A, etc. But it's hard to take SE out of the brain. I'm currently trying to develop a new and more rational treatment of how we engineer *Connected Systems*, a subject I believe needs fresh thinking since the basics were laid down some 20 years ago. I gave a tutorial on this at ASEC 2018, and will return to the subject if or when I have something useful to add.

What education/qualifications do you have for Systems Engineering?

I graduated with a degree in Physics from Swansea University in 1967, supplemented by an MSc in Physics of Electronic Devices from University of London in 1970 while in my first job. I've never regretted the choice of subject, which has given me a life-long interest in trying to explain logically how things work and how to build them, using models wherever possible. My real education in SE came from the *school of life*, informed by the experiences detailed above.

Getting an INCOSE Fellowship in 2015 was very satisfying. The citation read: '*For Innovation in Enterprise Systems Engineering and Education in Coping with Complexity*'. I'll happily settle for that.

What is it about Systems Engineering that you find so compelling?

It's intriguing and frustratingly complex, but extremely effective when done well by skilled people. Although theory and logic both matter, the decisive factor (as in all engineering) is what works, so engagement in the real world is absolutely essential to maintaining one's knowledge. (To quote Yogi Berra: *In theory, there is no difference between theory and practice, but in practice there is.*) Alternating between the two has been decisive in maintaining my own interest and approach. I did my last piece of consultancy 2017, and have now reverted to a more reflective mode, punctuated by occasional talks.

My interest has been sustained over the years by having the opportunity to share experiences and debate ideas with the kinds of motivated, intelligent and like-minded people who are attracted to INCOSE, as well as working for diverse organisations who are grappling with difficult problems in real world, and are in need of what we can offer.

What advice would you give a Systems Engineer just starting out in their career?

Try to work in as many domains as you can over time, so you can see for yourself the variety of problems which are out there, how SE can be adapted for different circumstances, and which parts are truly enduring and generic. Although you should read and go to conferences, lectures and training courses, much of this has to be experienced at first hand to give you the required confidence and competence. Failures, although painful at the time, can be the most instructive.

Maintain your intellectual curiosity – keep questioning and learning. The world is changing fast and you need to be equipped with the latest tools and methods. So don't accept stale or superficial explanations or let yourself stand still. Reading widely inside and outside the subject can add perspective. (I'm currently engrossed by latest thinking on evolutionary biology and the history of engineering, which I find stimulates fresh ideas relevant to the modern world.)

Remember that you are potential ambassadors for the subject and conduct yourself accordingly. Don't revel in the complexity of SE for its own sake, especially with clients. You will, quite rightly, be judged by delivering results that solve real problems of concern to customers: this requires empathy and appropriate language, so put those first and foremost.

Finally, I would wish any young systems engineer tremendous good fortune. You have chosen a rewarding and interesting field and should have no difficulty in being gainfully employed. The world I started working in 50 years ago is unrecognisable in almost every respect - socially, technologically, commercially and environmentally. The future is even less predictable and you will have a role to play in helping clients, organisations and even national bodies to navigate and shape it. Doing so will require reaching out beyond your comfort zone – with some boldness.

Best of luck!

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