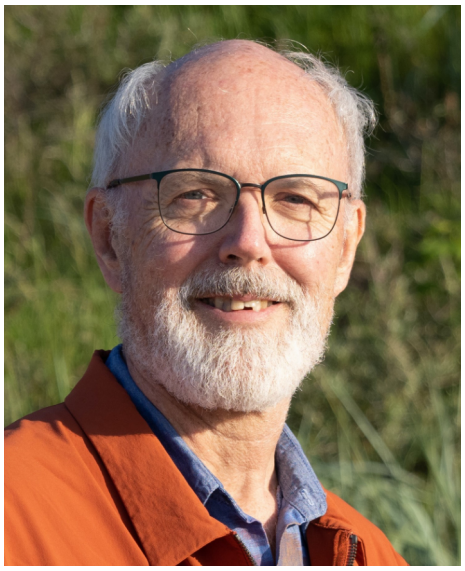
I Am a Systems Engineer and I Do...

Hillary Sillitto



Why did you choose to be a Systems Engineer?

I didn't choose, it just sort of happened.

I started working life as an optical engineer in the Laser Systems group of Ferranti (as it was then) in Edinburgh. I moved progressively from optical engineering to optical system design, to taking more of an interest in, and responsibility for, the higher level system of which the optics formed part. Then my job title started including the word 'system'. Later, I moved to Pilkington (now Thales) Optronics with a remit to help the company move up the system value chain, so I thought I'd better find out a bit more about systems. I started going to professional meetings and conferences, heard and was inspired by Derek Hitchins (founding president of INCOSE UK), and then got involved in INCOSE to see what value it could bring to my employers.

Now maybe there was more to it than just chance. Optical systems comprise of several individual elements none of which can do anything useful on their own, but when correctly integrated into a precision mechanical structure produce good quality images, or direct the light in exactly the right way. So everything to do with optics is to do with systems, the emergent properties you get when you combine several elements in just the right way in the relevant environment. So maybe my career was in systems all along, just different kinds – purely 'technical systems' to begin with, and much later getting involved in socio technical systems and much later again in systems science.

What education/qualifications do you have for Systems Engineering?

BSc Honours Physics at St Andrews, and Applied Optics MSc at Imperial. Later, CEng by experience through the Institute of Physics, and later again Fellow of the Institute of Physics. Then I was elected an INCOSE Fellow and invited to be one of the first candidate ESEPs in the validation pilot, both in 2009. I was a visiting professor at the University of Bristol Systems Centre for several years, and later at the University of Strathclyde. Finally, a great honour to which I feel I have not been able to do justice, I became an Ordinary Member of the Omega Alpha Association, the Systems Engineering Honor Society, in 2016.

In terms of learning to become a systems engineer, I learnt mostly on the job, with lots of experience in lots of different kinds of system and several different organisations at different levels of seniority; and I read books and journals voraciously. I'd particularly recommend Rechtin on Systems Architecting, Donella Meadows on 'Thinking in Systems'; also Don Reinertsen's books on product development engineering and Fred Brooks' 'Mythical Man Month' on software engineering if that's the level of SE that you're working at; and of course INCOSE's own house journals, Systems Engineering and Insight.

My physics degree was a huge help, because we learnt a lot about working across very different scales and levels of abstraction, and acquired a thorough respect for experimental evidence and experimental errors. In my subsequent work on optical sensor systems I learnt a great deal about noise in data, how to find the signal in the noise, and a healthy suspicion of any data that looked implausibly clean!

I should also mention my own publications, on the basis that there is nothing like trying to write about a subject to really learn about it. My book 'Architecting Systems', which I wrote after I retired and published in 2014, evolved from the lectures I gave for several years to the Sustainable Systems Course at the University of Bristol Systems Centre, and includes all of my favourite references. Some of the INCOSE Symposium papers that I presented and co-authored are still relevant and offer a different and (I hope) more holistic perspective than much of the INCOSE conference content. I contributed to the Systems Engineering Body of Knowledge (SEBOK), and to the INCOSE Handbook; and I led the Fellows' project to update INCOSE's definitions of system and Systems Engineering.

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

It's finding that principles that you discover or successfully apply in one domain are readily transferrable to others, so you're always learning and always finding new ways to apply what you've learnt.

Some of the engineering process documents I wrote for Pilkington Optronics were helpful to the Aircraft Carrier team when I got involved with them. Stuff I learnt in the late 1980s about infra-red surveillance and countermeasures systems came in handy 20 years later when I was chairing design reviews and helping to sort out problems on a new generation missile warner. When I was in the joint industry phase review team for the Aircraft Carrier programme, I heard on the grapevine that I had the makings of quite a good naval architect!

Post retirement, I can make better sense of the various 'systems' in the yacht I co-own with a friend, thanks to my background in Systems Engineering. At a totally different scale, a systems approach is vital in the effort to combat climate change, from the soft systems approaches needed to get agreement to rapid cuts in global emissions at CoP26, to the focused Systems Engineering of the lower level systems that need to be developed or adapted to deliver those cuts. (And it's not just about climate change – we have to solve climate change without crashing up against other planetary boundaries such as land use, water supply, and biodiversity.) And an understanding of systems was a huge help in my most recent endeavour, which is effectively an enterprise architecture vision for the future of a whole country – the book Scotland 2070: Healthy, Wealthy and Wise, which I co-wrote with two friends, was published last year.

So Systems Engineering and Systems Thinking are highly transferrable skills, and increasingly important and relevant to the big problems that face society. Indeed it's probably fair to say that all the hard problems we face are transdisciplinary system problems, because anything within the scope of a single discipline can generally be solved with existing knowledge.

What advice would you give a systems engineer just starting out in their career?

First, in the words of the Niels Bohr character at the very end of the excellent play Copenhagen, "you have to ask the right question." If a job is complex enough to need Systems Engineering, no one person can possibly know all the answers – but no one person has to. The important thing is knowing what and who (and when) to ask, what do with the information when you've got it, and to keep asking questions till the answers stop surprising you. If they surprise you, it means you haven't yet understood how everything fits together.

Second, a plan that assumes nothing will go wrong isn't a plan, it's a prayer! Every Systems Engineering project is a learning journey: learning about the problem, the system, the context, and the people and processes involved in developing and operating it (and who may wish to disrupt it). At each point in the programme, the plan and the system architecture must have the flexibility to handle the expected level of uncertainty and change. And always have a plan B – in my experience, the better the Plan B, the less likely you are to need it.

Third, any engineering or operations team is a complex socio-technical system in its own right, with everything that implies. "All hard systems exist inside soft systems, and it's the soft Systems Engineering that's really hard!" If you're coming in as an outsider, to 'help', it's very easy to trigger the organisation's immune response. You must learn how not to.

Finally, you can't design a system until you know how it's going to be used. Understand the main and emergency operational scenarios. In most high integrity systems, designing for the nominal behaviour is relatively easy. The bulk of the work is to deal with exceptions, including things that may never happen but would be catastrophic if they did. And remember, the main complexity factor in most systems and processes is not the technology, but human behaviour.