

Invited Keynote: *Challenges of the Third Age of Systems Engineering - “open systems on a closed planet”*

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Abstract: In the prehistoric era of systems engineering, many successful systems were created and used, from the complex organisational and societal systems that built the pyramids, to networked command, control and intelligence systems in the first half of the 20th Century.

Systems Engineering (SE) became recognised as a distinct activity in the second half of the 20th Century, driven by the American efforts on ballistic missiles, nuclear submarines, and the space programme. In that era, which I think of as “the first age” of systems engineering, the system of interest was regarded as pretty much a closed system. It had a clear boundary, and limited interactions with the “rest of the world”, which was an infinite source of resources, and an infinite sink for waste. So the first age of systems engineering could be characterised as “closed systems in an infinite environment”.

Towards the end of the twentieth century, systems started to interact with each other and form “systems of systems”. So the design paradigm had to shift to recognise most systems as open rather than closed. So the second age of SE was “open systems in an infinite environment”.

But our environment isn’t infinite. Man-made systems now span the planet, and interact with each other on a planetary scale. Our planet is the source for all our resources except for solar and tidal energy; and it is the sink for all the waste we produce. This has led to a new focus on sustainability, environmental concerns, resilience, and discussions on governance of planetary scale systems. So we are now in the “third age of systems engineering - open systems on a closed planet”!

What does this mean for the systems engineering community? Some obvious factors include a need for efficiency in the way we use energy, materials and other resources. Other factors are perhaps even more far reaching. The pace of change is increasing. It took a century for cars to saturate the market, 30 years for televisions, not much more than ten for mobile phones, and five for smart- phones and tablets. Information grows and circulates in a way unimaginable a few decades ago. This creates massive and increasing cognitive overload, and massive opportunities to leverage information to create value and societal benefit. And it creates massive risks - how do we manage and mitigate unintended consequences of system interactions we don’t fully understand, and maybe don’t even realise exist?

How do we apply and integrate what we know in our different communities to improve our ability to respond to these problems? The International Council On Systems Engineering recently published its Systems Engineering Vision 2015 and is reaching out to many other bodies in a spirit of collaboration to improve the way we apply wider knowledge to systems engineering, and improve the way we apply systems engineering to wider problems. A key element of this is systems architecture - as systems become more interconnected, system architecting methods help us to explain and contain complexity. The presentation will spell out some of the challenges, and show some snapshots of how the Systems community is trying to approach them.

Hillary Sillitto, 12th January 2015

Bio: Hillary Sillitto is a Chartered Engineer, Fellow of the Institute of Physics (FInstP), Fellow of the International Council On Systems Engineering (INCOSE) and Visiting Professor at the University of Bristol Systems Centre. After reading Physics at the University of St Andrews in the 1970s he worked for Ferranti in Edinburgh and Thales in Glasgow and elsewhere. He was seconded to the MoD from 2005-8 to run the Integration Authority, responsible for work to assure and improve system of systems integration. Returning to Thales UK he became Systems Engineering and Architects Manager for the Land and Joint Systems Division, and then Thales UK’s Systems Engineering Director. He left Thales in 2013 and is now pursuing a variety of academic and professional interests. His book “Architecting systems – concepts, principles and practice” was published in October 2014.