

I Am a Systems Engineer and I Do...

Joshua Sutherland

Why did you choose to be a Systems Engineer?

From a young age I was always interested in megaprojects like Concorde, Brunel's infrastructure, and the Apollo Program. I would often accompany my father on international trips exploring the various megaprojects of the world.

When it was time to go to university, I postponed my Oxford entry for one year to work full-time at Delphi Automotive Systems as part of a placement program now under the patronage of HM King Charles III, where I acquired invaluable experience in supply chain management. This experience fuelled my interest in quality management and the Toyota Production System.

While at Oxford, I spent my summers working in a number of different engineering roles, culminating in my decision to found a consulting company in my third year. I also participated in several official international learning trips, including a tour of Dubai with Oxford Saïd + Stanford GSB + Harvard Business School. I graduated from Oxford with a Master's degree in Engineering Science — a solid foundation — but aware there was still much to learn.

Recognising the accelerating effects of software, I aimed to thoroughly immerse myself in the engineering lifecycle of high-assurance software. This was driven by a desire to learn best practices from engineers leading mission-critical projects. After evaluating several opportunities, I joined the BAE Systems Digital Intelligence Electronic Systems Group as a software engineer.

After a few years I started viewing client problems at a higher level of abstraction — and thinking about how to solve them more effectively. Engaging in countless hours of late-night research, I discovered the world of "Systems" and realised it was the solution I had been seeking.



Presenting at EMEA WSEC 2023 as deputy lead of INCOSE's FuSE - SE Foundations stream.



Guided by a mentor, I visited California's top engineering schools, including UCLA, CalTech/NASA JPL, and Stanford. I then crossed the bay to tour Tesla's newly opened Fremont factory, (the former Toyota and GM joint NUMMI plant) which I had read so much about in the writings of Womack, Jones, and Roos. After visiting, I realised that to master large-scale system designs, I had to follow Deming's famous journey to Japan. I promptly returned to the UK and arranged with the Japanese Embassy in London to study in Japan. I was awarded a full MEXT scholarship and in October 2013 I enrolled at The University of Tokyo.

What education/qualifications do you have for Systems Engineering?

University of Oxford — Engineering Science (MEng) I studied at St Catherine's College under the guidance of Professors Ainsworth, Gillespie, Byrne, and Cannon. Their dedication to integrating research with practical application (including Rolls-Royce aero engines) continues to shape my commitment to integrating theory and practice to this day. To enhance the education of future engineers, I held multiple elected leadership positions including:

- Oxford University Engineering Society - I organised

visits to BMW, Toyota, and the Joint European Torus.

- Department Joint Consultative Committee - I represented ~150 students as their sole representative on all administrative and academic matters.

****University of Tokyo — Systems Innovation (MEng & PhD)****

I joined Professor Aoyama's Manufacturing Systems Engineering Laboratory because of its cross domain approach (Aerospace, Automotive, Electronics, Maritime, etc.) and deep industrial collaborations (including Toyota and Mazda).

My research goal was to advance the state of Knowledge Management in Systems Engineering by applying the principles of MBSE to improve the performance of engineering teams. I built upon the ideas of conceptual modelling with Object Process Methodology (OPM) and introduced dynamics with Modelica. I initiated fruitful collaborations with Dassault Systèmes and Professor Salado and took on Modelon as a client over the summer to further develop these ideas.

To support the department, I organised and led several international knowledge sharing tours to places like MIT, SpaceX, Boeing and various Formula 1 teams. I also conducted a personal tour of over a dozen Japanese engineering firms and megaproject sites to further my understanding of Japanese engineering and management approaches. These experiences proved valuable when I later helped support the visits to Japan of various international engineering dignitaries, such as Russell Peak (Georgia Tech), Rick Steiner (University of Arizona), Eric Rebertisch (MIT) and Olivier de Weck (MIT).

While working on my PhD I received a number of compelling opportunities that I couldn't pass up. As such, on the advice of my mentors and with the full support of my advisor, I plan to complete my doctoral write up when time permits.

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

The compelling nature of Systems Engineering lies in its capacity to enhance humanity's ability to conduct large scale scientific research. My main areas of interest are Research, Consulting, Education, and Contributing to the Systems Engineering Community.

****INCOSE — Future of Systems Engineering (FuSE) Initiative****

I am the Deputy Lead of the Foundations stream along with Stream Lead Professor Olivier de Weck (MIT). I have conducted experiments, organised workshops and presented results at all of the last four international INCOSE conferences, listed below:

- IW 2023 - Torrance, California
- EMEA WSEC 2023 - Sevilla, Spain
- SWISSED 2023 - Zürich, Switzerland
- IW 2024 - Torrance, California

We are integrating our findings into the SE community with the rest of the FuSE team, including Bill Miller, Erika Palmer, Paul Schreinemakers, Chris Hoffman, and Tom Strandberg.

**** Ford Motor Company — Michigan, USA****

I supported the design and development of the next generation (not yet released), all-electric F-150 and the production system that will produce it at scale. My primary role was to improve group coordination processes and product quality by integrating SysML and model based approaches into the workflow of the F-150 Systems Integration team. I played a major part in developing company-wide federated SysML models, and I oversaw the development of models by dozens of team members from around the world — and ensured appropriate tailoring to individual regulatory regimes. I revamped our knowledge management processes so that the best practices we developed in the Michigan headquarters were shared with all of our key global design and production centres (including Australia, Brazil, Germany, Mexico and the UK). On a daily basis I coordinated and consolidated the efforts of 30+ engineers spread across 5 different time zones.

****European Space Agency (ESA) — UK. Switzerland. Germany. Netherlands.****

I am a founding member of an international group tasked with developing a system for structuring how ESA spends its €6 billion annual Research and Development budget. We are developing the next-generation technology roadmapping and strategic mission planning process which will oversee the allocation of that spending. I organised our collaborations with NASA, Airbus, and the University of Cambridge. Currently I am leading negotiations with the UK Space Agency to facilitate their adoption of the system.

****Education Contributions****

I have taught 13,000+ students both in-person and online in Systems Engineering and related subjects, including:

OPM and SysML for MBSE, Future Proof Planning, and Program Management for R&D.

****Contributing to the Systems Engineering Community****

I am the founder and host of “The Systems Engineering Podcast” which provides a platform for systems engineering thought leaders to share their ideas with the wider SE community. The podcast is the #1 ranked Systems Engineering podcast on Google, YouTube, Spotify and Apple Podcasts. Guests include:

- INCOSE Past Presidents: Alan Harding, Ivan Mactaggart, Hillary Sillitto and Heinz Stoewer
- Academics: Jon Holt and Bruce Cameron
- Entrepreneurs: Pari Singh and Jordan Kyriakidis

You can listen at: TheSystemsEngineeringPodcast.com

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

1. Commit to Your Craft and Be Useful:

Don't wait to be told what to do; be proactive.

2. Study the Future as Well as the Past:

Stay focused on the long term.

3. Reach Out if You Need Help:

Please don't hesitate to contact me at:

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4. Keep Learning:

Some important resources are detailed here: <https://www.joshuasutherland.com/best-systems-books/>