

**DANIEL J. EPSTEIN DEPARTMENT OF
INDUSTRIAL AND SYSTEMS ENGINEERING**

EPSTEIN INSTITUTE SEMINAR • ISE 651 SEMINAR

***Journey from Adolescence to Adulthood:
Systems Engineering 1994-2014***

Olivier L. de Weck, Ph.D.

**Professor of Aeronautics and Astronautics and Engineering Systems
Executive Director, MIT Production in the Innovation Economy (PIE) Study
Massachusetts Institute of Technology**

ABSTRACT

On July 1, 1994 the inaugural Issue of the journal *Systems Engineering* appeared with great fanfare. Is Systems Engineering (SE) any further along today than it was 20 years ago? Is it simply based on common sense and industrial experience? Or are there deeper scientific principles, methods and tools that now form the underpinnings of the discipline? In this seminar I will trace the evolution of Systems Engineering over the last 20 years and will look for clues whether the field has transitioned from adolescence to adulthood. I will do this by first relaying my personal journey from a practitioner of Systems Engineering on the F/A-18 and James Webb Space Telescope (JWST) programs to a scholar researching ways of observing, quantifying and eventually predicting complex phenomena that occur during the design and operation of complex systems. I will argue that an empirical approach involving data mining, pattern recognition and generalization may be more promising than trying to derive systems engineering fundamentals from "first principles" (without data) as was attempted in the – largely ignored - General Systems Theory of the 1960s. Some recent research results involving engineering change cascades, multi-domain network representations and the ability to accelerate the design of complex systems by a factor of 5 based on a new META approach will be presented and discussed. Industrial examples will include fighter aircraft, scientific satellites, radar systems, aircraft engines and amphibious vehicles. The seminar will conclude by showing some of the key trends in systems engineering for 2014 and beyond including Model-Based Systems Engineering (MBSE) and improved quantification of the "Illities" or lifecycle properties based on a keyword analysis of 1,275,870 scientific papers starting in 1884. My message will be that systems engineering fundamentals are much further along than many believe and that the discipline is indeed transitioning into adulthood.

**TUESDAY, NOVEMBER 12, 2013
GRACE FORD SALVATORI (GFS) ROOM 101
3:30 – 4:50 PM**

SPEAKER BIO:



Dr. Olivier L. de Weck

Professor de Weck is an international leader in *Systems Engineering* research. He focuses on how complex man-made systems such as aircraft, spacecraft, automobiles, printers and critical infrastructures are designed, manufactured and operated and how they evolve over time. His main emphasis is on the strategic properties of these systems that have the potential to *maximize lifecycle value*. His group has developed quantitative methods and tools that explicitly consider manufacturability, flexibility, robustness, and sustainability among other characteristics. Significant results include the *Adaptive Weighted Sum* (AWS) method for resolving tradeoffs amongst competing objectives, the *Delta-Design Structure Matrix* (\square DSM) for technology infusion analysis, Time-Expanded Decision Networks (TDN) and the *SpaceNet* and *HabNet* simulation environments. These methods have impacted complex systems in space exploration (NASA, JPL), oil and gas exploration (BP) as well as sophisticated electro-mechanical products (e.g. Xerox, Pratt & Whitney, GM, DARPA). He has authored two books and about 250 peer-reviewed papers to date. He is a Fellow of INCOSE and an Associate Fellow of AIAA. Since January 2013 he serves as Editor-in-Chief of the journal *Systems Engineering*. In 2006 he received the Frank E. Perkins Award for Excellence in Graduate Advising followed by the 2010 Marion MacDonald Award for Excellence in Mentoring and Advising and a 2012 AIAA Teaching Award. From 2008-2011 he served as Associate Director of the Engineering Systems Division (ESD) at MIT. From 2011 to 2013 he served as Executive Director of the MIT Production in the Innovation Economy (PIE) project.