The 1st Workshop on U.S. Undergraduate Programs in Systems Engineering

April 7-8, 2010
U.S. Air Force Academy, Colorado Springs, CO

Background

University offerings in systems engineering have expanded steadily over the past decade. The International Council on Systems Engineering directory of SE academic programs[1] lists 112 programs in 15 countries offering a mix of bachelors, masters, doctoral level and certificate programs in Systems Engineering and Systems Engineering management. Seventy-two of those programs are in the United States with more than 30 offering a bachelor's degree. *The 1st Workshop on U.S. Undergraduate Programs in Systems Engineering* will (1) analyze the current state of bachelor's degree programs in Systems Engineering across the United States, (2) explore where those programs are headed, and (3) propose actions that could be taken by academia, industry, and government to strengthen the value those programs offer to students, universities, employers, and the nation.

Workshop Goals and Products

The three goals of the workshop are to:

1. Explore the characteristics, successes, and challenges of U.S. bachelor's degree programs in Systems Engineering
2. Develop high-level proposals for how to reinforce the strengths of those programs and address their challenges, increasing their value to students and prospective employers in a way that is practical in today's challenging educational environment
3. Build a sense of community among U.S. faculty who operate undergraduate Systems Engineering programs in order to facilitate future exchanges of information and willingness to work together to refine and implement the high-level proposals developed by the workshop attendees

Program Committee

Dr. Donald Gelosh (Co-Chairman), DDR&E
Lt Col Paul Lambertson (Co-Chairman), USAF Academy
Dr. Art Pyster, Stevens Institute of Technology

[1] See http://www.incose.org/educationcareers/academicprogramdirectory.aspx

Workshop Agenda

Tuesday, April 6, 2010	
5:30p to 7:00p	*Earlybird Check-in and Icebreaker Reception (Embassy Suites)*
Wednesday, April 7, 2010	
6:45a and 7:00a	*Buses depart for AF Academy (Embassy Suites Portico)*
7:00a to 7:30a	*Check-in and Continental Breakfast (L1 Foyer, Fairchild Hall)*
7:30a to 7:45a	Welcome, Lieutenant General Michael C. Gould, *Superintendent, USAF Academy*
7:45a to 8:00a	Workshop Introduction and Logistics, Dr. Don Gelosh, *Systems Engineering Directorate, Defense Research and Engineering* and Lt Col Paul Lambertson, *USAF Academy*
8:00a to 8:30a	Keynote address, Mr. Stephen Welby, *Director, Systems Engineering, Defense Research and Engineering*
8:30a to 9:00a	Keynote address, Mr. Charles Toups, *Vice President and General Manager, Network and Tactical Systems, Boeing Network and Space Systems*
9:00a to 9:30a	Keynote address, Lt Col Paul Lambertson, *Director, Systems Engineering, USAF Academy*
9:30a to 10:00a	The BKCASE Project and an Analysis of U.S. Undergraduate Programs in Systems Engineering, Dr. Art Pyster, *Stevens Institute of Technology*
10:00a to 10:30a	*Break*
10:30a to 12:00p	***Panel Session 1:*** What are Best Practices in Teaching Systems Engineering to Undergraduates?
12:00p to 1:00p	*Lunch*
1:00p to 2:30p	***Panel Session 2:*** Should Systems Engineering Degrees Only Be Offered at the Graduate Level?
2:30p to 3:00p	*Break*
3:00p to 4:30p	***Panel Session 3:*** How Much Classical Engineering and Domain Focus Should Be in A Bachelor's Degree in Systems Engineering?
4:45p to 6:30p	*Evening Reception including table top displays by the USAF Academy highlighting their Systems Engineering undergraduate program, Lectinar Foyer*
6:30p	*Buses return to Embassy Suites*

Panel Descriptions

Panel Session 1: What are Best Practices in Teaching Systems Engineering to Undergraduates?

Systems engineering is about getting requirements right, deciding the right life cycle model, understanding customer needs, ensuring the right blend of specialty engineers are working together, and a myriad of other activities, often conducted with teams that are geographically distributed and working for multiple organizations. What are the best practices used to teach undergraduates about these many activities given the limitations in the experiences of a typical undergraduate?

Panelists: Michael Smith (chair), Roger Burk, Drew Hamilton, Seshadri Mohan, Armen Zakarian

Panel Session 2: Should Systems Engineering Degrees Only Be Offered at the Graduate Level?

The sheer existence of undergraduate degree programs in systems engineering is controversial. Because systems engineering is inherently multidisciplinary and requires many complex judgments, some academics and practicing professionals believe that anyone should first practice one or more specialized engineering disciplines for several years before *earning any SE degree. Those academics and practitioners believe that systems engineering degrees and certificates should only be offered at the graduate level. Yet this workshop is bringing together many successful offerers of undergraduate systems engineering degree programs. How can those two views be reconciled?*

Panelists: Dinesh Verma (chair), Dennis Barnabe, Thomas Mazzuchi, Timothy Trainor, Brian Wells

Panel Session 3: How Much Classical Engineering and Application Domain Focus Should Be in A Bachelor's Degree in Systems Engineering?

A classical undergraduate engineering degree is highly structured with few electives. Students usually have a common focus in the first two years on mathematics, design, chemistry, mechanics, electronics, and physics, somewhat independent of their engineering specialty. The last two years typically focus on advanced topics and team projects within the engineering specialty. Should students earning a bachelor's degree in systems engineering have their program structured much as a classic engineering undergraduate? Should they learn about systems engineering in the context of another engineering discipline such as industrial, chemical or biological engineering? Should students learn about systems engineering in the context of a particular application domain such as finance, telecommunications, or naval weapons systems?

Panelists: Don Taylor (chair), Paul Coffman, Brian Gallagher, Brett Peters, Ariela Sofer

Thursday, April 8, 2010	
7:15a and 7:30a	*Buses depart for AF Academy (Embassy Suites Portico)*
7:30a to 8:00a	*Continental Breakfast (Mini-Lectinar Foyer)*
8:00a to 12:00a	4 breakout groups work in parallel to answer: (1) What are the primary undergraduate education requirements for systems engineering personnel in government program offices? (Room 5D23) *Facilitator/Chair: Cliff Whitcomb, Naval Postgraduate School* (2) What are the top 5 challenges to successful bachelor's degree programs in systems engineering and how should those challenges be addressed? (Room 5D47) *Facilitator/Chair: George Donohue, George Mason University* (3) Within the first four years after graduation, what should someone with a bachelor's degree program in systems engineering know and be capable of doing on the job? (Room 5D49) *Facilitator/Chair: Michael Papay, Northrop Grumman Corporation* (4) How much classical engineering (general, industrial, mechanical, electrical, etc.) and application domain focus (telecommunications, naval, medical, etc.) should be in a bachelor's degree in systems engineering? (Room 5D31) *Facilitator/Chair: Paul Componation, University of Alabama, Huntsville* Each breakout group will document its deliberations in a presentation for the afternoon plenary session.
12:00p to 1:00p	*Lunch (Foyer Lectinar 1)*
1:00p to 2:30p	Breakout group presentations to all workshop attendees *(Lectinar 1)*
2:30p to 2:45p	*Break*
2:45p to 3:30p	Breakout group presentations continue to all workshop attendees
3:30p to 3:50p	Workshop summary and next steps by Don Gelosh and Paul Lambertson
3:50p to 4:00p	Workshop Close, Col Neal Barlow, *Chair, Engineering Division (College of Engineering); Permanent Professor and Head, Department of Aeronautics; and past USAFA Vice Dean*
4:00p	*Adjourn and board buses to Embassy Suites*

More About Our Welcome, Keynote and Closing Speakers

Lieutenant General Michael C. Gould

Superintendent, U.S. Air Force Academy

Lt. Gen. Michael C. Gould is Superintendent, U.S. Air Force Academy, Colorado Springs, Colo. The Academy provides a highly structured four-year regimen of military training, academics, athletic and character development programs leading to a Bachelor of Science degree and a commission as a second lieutenant. General Gould earned his commission and a bachelor's degree in behavioral science from the U.S. Air Force Academy in 1976. He has commanded an operations group, an air refueling wing, an air mobility wing and the Cheyenne Mountain Operations Center. He has also commanded the 3rd Air Force, Royal Air Force Mildenhall, England, and the 2nd Air Force, Keesler AFB, Miss. His operational and staff assignments include three tours at Headquarters U.S. Air Force, along with duty as an Air Force aide to the President and military assistant to the Secretary of the Air Force. He served as the Director of Mobility Forces for Operation Joint Endeavor and as USEUCOM's Air Expeditionary Task Force commander for the deployment of African Union troops into the Darfur region of Sudan.

Prior to assuming his current position, he was Director of Operations and Plans, U.S. Transportation Command, Scott Air Force Base, Ill. General Gould is a command pilot with more than 3,000 hours in a variety of aircraft.

Mr. Stephen P. Welby

Director, Systems Engineering
Office of the Director, Defense Research and Engineering (DDR&E)

Mr. Stephen P. Welby is the Director, Systems Engineering for the Director, Defense Research and Engineering, in the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics. Mr. Welby is responsible for establishing both systems engineering and acquisition technical workforce policy across the Department of Defense (DoD). This includes early systems engineering and pre-acquisition development planning programs; system design, development and manufacturing policy; and independent program review and analysis for more than $60B per year in major weapon system acquisition programs across the Department. As acquisition technical workforce executive, Mr. Welby is the Department's systems planning, research, development, and engineering (SPRDE) functional leader, as well as the production, quality, and manufacturing (PQM) functional leader; together these career fields encompass more than 40,000 DoD acquisition professionals.

Mr. Welby has more than 22 years of government and industrial experience in cross-disciplinary technological product development, including leadership positions at the Defense Advanced Research Projects Agency (DARPA). His areas of focus included technology and program management for development of advanced aeronautical and space systems, high energy lasers, ground and maritime systems, robotics, advanced weapons, high-performance software, real-time signal and image processing, and military sensor systems.

Mr. Welby holds a bachelor of science degree in chemical engineering from The Cooper Union for the Advancement of Science and Art, a master's degree in business administration from the Texas A&M University, and master’s degrees in computer science and applied mathematics from The Johns Hopkins University.

Mr. Charles Toups

Vice President and General Manager, Network and Tactical Systems
Boeing Network and Space Systems

Charles Toups is vice president and general manager of Network and Tactical Systems (N&TS), a division of Network and Space Systems within Boeing's Defense, Space & Security (BDS) business unit. He was named to this position in January 2010.
N&TS is comprised of nearly 3,800 employees in 30 states and international locations who are dedicated to designing and delivering network-centric solutions for a range of global defense, commercial and civil customers. Key N&TS programs include the Brigade Combat Team Modernization program for the U.S. Army, the Joint Tactical Radio System Ground Mobile Radios for the Joint Program Executive Office, JTRS, the Family of Advanced Beyond Line-of-Sight Terminals for the U.S. Air Force, the Avenger short-range air defense system, and the Vigilare and Modernised High Frequency Communication Systems for the Australian Defence Force. N&TS continues to develop the System of Systems Common Operating Environment, as well as robotics solutions for both military and civil applications.

Toups joined The Boeing Company in 1982 and has held a number of senior engineering and management positions throughout his distinguished career. Prior to his current position, Toups was vice president of Engineering and Mission Assurance for BDS. In that role, he was responsible for ensuring world-class technical integrity for all BDS products and services. He led a 30,000-person international engineering organization that included teams across the BDS business. In addition, Toups led a companywide effort to improve quality and productivity, called Lean+ 10X, which is part of Boeing's approach to continuous improvement. In other assignments, Toups served as vice president of Engineering and Operations at Boeing Satellite Systems and as its vice president of programs. He headed the procurement, development and production phases of the Modular Communications Program, which was honored with both the Department of Defense David Packard Excellence in Acquisition Award and the National Reconnaissance Office Gold Medal of Distinguished Performance.

Toups earned a Bachelor of Science degree in engineering from University of California at Irvine in 1980 and a Master of Science degree from Massachusetts Institute of Technology in 1982. He completed a Sloan Fellowship at Stanford University Graduate School of Business and earned a Master of Science in Management degree in 1997.

Lieutenant Colonel Paul C. Lambertson

Director, Systems Engineering, U.S. Air Force Academy

Lieutenant Colonel Lambertson is a graduate of the U. S. Air Force Academy Class of 1990. He attended undergraduate pilot training at Reese AFB, TX. He has served in operational assignments in aircraft maintenance, aircrew life support, command/control, as well as, KC-135R/T, C-12F (ACE), C-17A and T-52 aircraft. As an aircraft maintenance officer on B-1 and KC-135 aircraft, he led the Sortie Generation Flight in Air Mobility Command's (AMC) 1994 Outstanding Air Refueling Squadron. As a KC-135R/T Formation Lead, Special Operations Instructor Pilot he flew numerous combat/combat support missions in OPERATIONs; PROVIDE COMFORT, SOUTHERN WATCH, DECISIVE ENDEAVOR and DENY FLIGHT. As Commander of the 437th Airlift Wing's Aircrew Life Support Flight, his team was honored as AMC's 2001 Outstanding Aircrew Life Support Flight (Large Team). As a C-17A Examiner Pilot, he flew additional combat/combat support missions in OPERATIONs; ALLIED FORCE, ENDURING and IRAQI FREEDOM. As a Mission Commander/Instructor Pilot for Operation DEEP FREEZE, he led numerous C-17A personnel for National Science Foundation support to Antarctica. As Chief, Future Concepts and Transformation Branch he was named the "Architect of AMC's Science & Technology enterprise" by AMC's Director of Strategic Plans, Requirements and Programs. He was largely responsible for the Secretary of the Air Force authorizing and the Commander, AMC hiring the command's first Chief Scientist. He currently serves as the Director of Systems Engineering at the United States Air Force Academy. The Systems Engineering major is the Academy's second most popular engineering major. Lieutenant Colonel Lambertson is a Command Pilot with more than 3,000 hours of flight time.

Colonel Neal D. Barlow

Chair, Engineering Division; Permanent Professor and Head, Department of Aeronautics; Past Vice Dean of the Faculty, U.S. Air Force Academy

Colonel Barlow is the Chair of the Engineering Division and Head of the Department of Aeronautical Engineering at the United States Air Force Academy. Since 2000, he has also served as the Permanent Professor of the Academy's Department of Aeronautics. As the Chair of the Engineering Division (College of Engineering) he oversees the efforts of the Departments of: Aeronautical Engineering, Astronautical Engineering, Civil Engineering, Electrical and Computer Engineering and Engineering Mechanics. The Division is also home to the Systems Engineering program. During 2004-2005, he served as the "Mayor of the Green Zone" in Baghdad, Iraq while assigned as the Director of the Multi-National Force's Joint Area Support Group. Prior duties include the 34th Operations Group Deputy Commander and Commander of the 94th Flying Training Squadron. In 1997, he commanded the 4417th Support Squadron and served as Base Commander at Ali Al Salem Air Base, Kuwait.

Col Barlow is a 1978 distinguished graduate of the Air Force Academy with a degree in aeronautical engineering. He received his master’s of science degree in aeronautical and astronautical engineering as an Order of Daedalian Fellow from the University of Washington and a Ph.D. in aerospace engineering from Arizona State University.

Col Barlow is a command pilot with more than 4,000 flying hours. In his 24 years of instructor experience, he has served at every level of undergraduate flight training from line instructor pilot, to PIT instructor, to command evaluator. His Air Force instructor experience includes the T-38, T-41, T-3 and T-G7 aircraft along with civilian instructor experience in numerous aircraft types. He has commanded at the squadron and group levels including two commands while deployed to Iraq.