Weber State University Engineering, Applied Science & Technology
Systems Engineering Proposal Brief 2020

Partnership

Weber State University (WSU), through the College of Engineering, Applied Science & Technology (EAST) and the Computer Science, Electrical Engineering, Mechanical Engineering, Manufacturing & Systems Engineering, and Physics Programs will work with and accommodate the needs of industry partners on the Wasatch Front, utilizing INCOSE, DoD standards, to provide Systems Engineering education.

The location of Weber State in Ogden, Layton, and Farmington creates a unique opportunity to provide education convenient to the aerospace and manufacturing community of Northern Utah. Currently, for example, HAFB employs more WSU graduates in engineering than from any other school in the nation; and our location allows us to teach specialized programs on base. As a teaching university, WSU has proven itself an excellent return on investment both in terms of student dollars and state and corporate investment. Small classes, instruction by full-time faculty, hands-on and project-based learning means our students should be able to hit the ground running, so to speak, both technically and socially.

- Weber State University—Dean David Ferro and systems engineering faculty David Wetzel, Nicole Batty, and Dustin Birch of College of Engineering, Applied Science & Technology
- L3/Harris, Northrup-Grumman, Hill Air Force Base (HAFB), Lockheed-Martin, Moog, Boeing, Borsight, Stadler, Sarcos, Stryker, Kihomac, Barnes Group, Williams International, and numerous others
- Industry advisors assembled by Ben Hart and Kimberlee Carlile for GOED meeting: Brian Mcquivey, Misty Porter-Belch, Tyson Kelly, Randal Sylvester, Jon Liddle, Stephen Guine, Willaim VanJones, Megan Ware, Teresa Schlegel
- Advisors for this proposal include Paul White, John Richards, Misty Porter-Belch, Angie Harbert, Rachel Geerlings, Ernest Kyed, Vince Johnston, John McCrea, Paul Nelson, John Metcalf, Ben Goldberg, Charles Precourt of Wasatch INCOSE and Dave Hansen, Jay Fiebig, Jeff Kwok, Jim Vanfleet, Norm LeClair of the HAFB, Department of Defense. Some of these individuals sit on our systems engineering industry advisory board. See Appendix B.

Board of Trustees Support—The Board of Trustees will send a separate message of support.
Presidential Support—The President will send a separate message of support.

Proposal

EAST shall provide a number of paths for systems engineering ‘thinking’ to address the various systems engineering requirements. Selected coursework is designed to prepare students for professional certification within INCOSE. We wish to work with our university partners at the University of Utah and Utah State to create pathways between our programs separate from those explicated here. We also believe there are opportunities to create stronger pathways with the high schools.

Table 1 – Systems Engineering Pathways and Outcomes Weber State University	
Pathway	**Level**
(Existing) BS in Systems Engineering (manufacturing emphasis) (ABET next year) - John Richards at Northrup-Grumman expressed appreciation for the manufacturing (including hands-on) emphasis of this BS for the manufacturing systems needs for his company and the Wasatch Front. - Existing courses focus on industry needs as detailed in response to Ben Hart's request for job listings. - Modify courses for both online and brick n' mortar delivery.	B.S.
Concurrent Enrollment in Systems Engineering - Working with the school systems and state to have existing Foundations of Systems Engineering count as concurrent enrollment class increasing likelihood of increased enrollment in systems engineering courses in college.	H.S.
BS-level Institutional Certificate in Systems Engineering - Utilizing existing and new courses in systems engineering to allow for an undergraduate certificate in systems engineering. - Courses: Foundations, Engineering Project Management, Analytics, Systems Dynamics & Architecture, Systems Requirements. - Certificate available to STEM majors. - Utilizing hybrid approach to instruction (brick n' mortar, online, combined) to accommodate student needs. - Existing Manufacturing Systems degree recipients automatically get Certificate.	B.S.
Systems Engineering Courses (for certificate) Counting as Electives for Other Majors - Working with Electrical and Computer Engineering, Computer Science, Mechanical Engineering, and Physics to have lower- and upper-division courses in systems engineering count towards those majors. - Those courses could then count towards undergraduate certificate - Utilizing hybrid approach to instruction (brick n' mortar, online, combined) to accommodate student needs.	B.S.
MS Certificate (15 credits) in Systems Engineering - Working with industry to create best certificate beyond BS level. - Utilize existing BS courses plus project and advanced assignments to get more bang for the buck – currently the approach we take for our EE, ECE and CS degrees. - Utilizing hybrid approach to instruction (brick n' mortar, online, combined) to accommodate student needs.	M.S.

MS Degree (30 credits) in Systems Engineering - Extending MS certificate to full MS degree - Project-oriented vs. Thesis - Utilizing hybrid approach to instruction (brick n' mortar, online, combined) to accommodate student needs. - Accelerated pathway for MS degree for those students with BS Certificate. - See Appendix A for support letter for this degree from HAFB.	M.S.
Outcomes	
- **G**ain **ABET accreditation for BS systems degree.** - Implement all Systems pathways. - Track number of enrollments, graduates, and work-based learning in each pathway.	

Table 2- Optimum Budget

Weber State University

Funding Need	**Budget**
Faculty – Program Coordinator **-** A faculty position to direct and coordinate BS, MS classes/programs. person would a. Hold a PhD in Systems Engineering as well as have 3+ years of industry experience. b. Work with industry and industry groups to focus curriculum development c. Liaison with secondary teachers, CTE coordinators, and concurrent enrollment coordinators to increase concurrent enrollment instruction in secondary schools d. Liaison with admissions, registrar, financial aid, and continuing education e. Work with industry partners to increase Work-Based Learning opportunities such as internships f. Oversee course design, curriculum development, analysis, and revision g. Arrange for professional development for instructors h. Manage admissions and scholarships i. Coordinate and oversee Academic Coach/Advisor j. Manage the budget k. Schedule courses l. Teach a minimum of six courses per year at the university to offset the increased demand for university-level instructors	$135,000 (ongoing)
Instructor – An instructor position *match* to teach systems engineering a. Hold a MS in Engineering as well as have 5+ years of industry experience in systems engineering. b. Teach a minimum of eight courses per year at the university to offset the increased demand for university-level instructors	$65,000 (ongoing)

***Course Design, Development, and Updating* – University educators will engage in preparing and maintaining the curriculum. For each course educators will** a. Design and develop course curriculum to be used by multiple instructors b. Engage in collaborative design to improve quality of materials c. Create instructional materials for online learning d. Develop assessments to identify mastery e. Incorporate structures to facilitate flexible progress f. Analyze effectiveness of material and student engagement g. Update existing courses to maintain topic relevance and educational quality h. Create online options	$20,000 (one-time)
Marketing includes Rack cards, cards, posters, and videos as promotion for events such as STEM Expo, high school and college career fairs and classes, majors fairs, college sessions, company visits, info sessions.	$2,000 (one-time)
Total One-time Funding	$22,000
Total On-Going Funding	$200,000

Curriculum

These ten courses are the core of the BS/MS degrees in Systems Engineering at Weber State. These courses (along with existing majors) include the software systems and standards required for industry.

Foundations of SE
The Foundations of Systems Engineering course is an introductory overview of the systems engineering perspective and is presented to set the conceptual and practical framework of the entire systems engineering graduate program. The course covers the foundational components of systems engineering, from the concept development stage through the process steps of engineering development. Several issues related to post-development and special topics areas are also presented.

Engineering Project Management & Risk Analysis

Engineering program management fundamentals, program planning and control strategies, risk assessment, work breakdown structures and costing options. This course is targeted to technical personnel and those who work with technical personnel on engineering projects. Successful engineering project management includes estimation and proactive risk identification and development of mitigation techniques. System uncertainty is reduced when project risks are identified, quantified, and mitigation strategies implemented. Tools, techniques, and methodologies used by successful project managers will be examined.

Analytics in Systems Engineering

This course will provide students with understanding of the fundamentals of using industrial data analytics techniques to transform from data-rich into decision-smart. It focuses on training students with the ability of formulating and solving real industrial problems with the appropriate modeling strategies and analytics principles for better decision making.

System Dynamics & Architecture

This course deals with understanding the higher-level behavior and issues that emerge from interaction between components in complex socio-technical systems. Illustrate the techniques of Model-Based Systems Engineering (MBSE) using an architecture model as the primary source material for Systems Engineering (SE) processes such as requirements analysis, high level and detailed design, performance and design trade studies, configuration management, specialty engineering, and others.

Systems Requirements Engineering

Introduction to the rigorous requirements process within systems engineering, including system requirements analysis elicitation, analysis, requirements decomposition, allocation, traceability, verification, and validation.

Engineering Optimization: Method/Application

This course will Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods. Numerous applications are presented in civil, environmental, electrical (control) engineering, and industrial engineering. The goal is to maintain a balance between theory, numerical computation, problem setup for solution by optimization software, and applications to engineering systems

Design for Operational Feasibility

This course will introduce the application of engineering and management efforts to maximize the likelihood that the resulting system design will be operationally feasible, and perform as intended in an effective and efficient manner. The objective of the course is to present areas of design that are known to have a significant impact on the ultimate worth of a system and the customer need. Topics include: Design for reliability, maintainability, human factors, logistics, producibility, and affordability.

Systems Test and Evaluation

Test and evaluation of systems at both the component and systems levels to provide insights into how systems succeed or fail based on test methodologies. To gain a better understanding of what test & evaluation is and why its importance among government agencies and private industry has continued to increase over the last three decades. To understand the various roles test & evaluation can and should play in the business, programmatic and technical dimensions of each acquisition program.

System Logistics
Ensuring a System of Systems Approach

This course will introduce the subsequent sustaining maintenance & support of the system throughout its entire life cycle, including end of life/disposal. It will also include different DoD tailorable concepts to effectively manage and field product. Topics include: Reliability Growth, Initial Contractor Support (ICS), and Performance-Based Logistics (PBL).

Project / Independent Study

Typical examples are research and other courses where the objectives and activities are determined jointly by the instructor and the student. In most cases, the agreement on course activities and objectives is reached with the student and advisor or instructor before enrollment in the course.

Appendix A

AFSC/EN OL-Hill
5851 F Ave Bldg 849
Hill AFB, UT 84056-5713

Professor George Comber
Chair, Engineering Technology Department
1447 Edvalson St. Dept. 1802
Weber State University
Ogden, UT 84404-1802

Dr. Comber,

I am sending this letter to acknowledge that the proposed Weber State University (WSU) Masters of Science in Systems Engineering (MSSE) appears to align directly with enduring skills needed by various organizations at Hill Air Force Base (AFB) such as the Ogden Air Logistics Complex, 75th Air Base Wing, 748th Supply Chain Management Group, the Air Force Life Cycle Management Center, and the Air Force Nuclear Weapons Center.

The Air Force relies on its scientists and engineers to solve a wide variety of problems involving highly-technical equipment and systems, and to ensure effective sustainment (e.g., maintenance, repair, overhaul, modification, local manufacturing, supply chain management, life cycle logistics, etc.) of current and future weapon systems.

While Hill AFB is only one stakeholder in the Aerospace & Defense, Advanced Materials & Manufacturing, and Software & Information Technology sectors in Utah, it has over 2,600 science and engineering professionals who already have BS degrees. These civilian and military members are encouraged, (and tuition is typically funded), to pursue advanced degrees. The proposed Weber State University MSEE could be an attractive option for their professional development.

Although Hill AFB cannot endorse any particular degree program or academic institution, having an MSSE or similar degree program within commuting distance of Hill AFB would be of value in elevating the technical expertise of the civilian and military workforce. I appreciated the opportunity to participate along with other industry stakeholders in reviewing the proposed curriculum and believe it aligns with our strategic objectives. If you need further clarification of our workforce requirements and priorities, please contact our Engineering and Technical Resource Management Division Chief, James Vanfleet at (801) 777-3831 or james.vanfleet@us.af.mil.

JEFFREY D. KWOK, Colonel, USAF
Deputy Director, Engineering & Tech Management

Appendix B

MSE IC Contacts

IC Member	Company	email	note
Paul White	KIHOMAC	paul.white@kihomac.com	Senior Systems Engineer, CSEP
Vincent Johnston	L3T	Vincent.b.Johnston@l3t.com	Senior Systems Engineer, ESEP
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Mark Ripke	Boeing	mark.ripke@boeing.com	Chief Engineer
Kevin Johnson	Williams International	KJ7342@gmail.com	Manufacturing Systems Engineer / Business Intelligence
Jason VanArk	Williams International		Automation Manager
Guy Letendre	WSU		Economic Development Director