



Developing a Space-Focused Systems Engineering Curriculum

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NASA Headquarters***

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Motivation



- ◆ **The Exploration Systems Mission Directorate (ESMD) recently established the Constellation Program Office (CxPO) at JSC with the focus on managing the numerous development projects to enable NASA to go to the moon, Mars and beyond.**
- ◆ **The primary responsibility of this new program is to perform the systems engineering on the numerous systems under development - from today and for decades to come.**
- ◆ **The University of Texas at Austin (UT Austin) is responding to the NASA Administrator's call to develop systems engineers for NASA's exploration future.**



Response



- ◆ **Under the sponsorship of ESMD, UT Austin has invited Ms. Lisa Guerra to help create a systems engineering program within aerospace engineering to be responsive to the post-2010 needs of ESMD and the CxPO.**
- ◆ **The intent is for the curriculum/program to be a pilot, transferable to other universities operating within NASA's Space Grant Consortia.**
- ◆ **Ms. Guerra, a former graduate student at UT Austin, has 20 years of aerospace experience, both as a contractor and NASA civil servant, spanning 3 NASA Centers across the field of systems engineering as applied to human spaceflight missions and space science missions.**



SE Curriculum Options (1/2)



Undergraduate

- 1. One-week systems engineering overview imbedded in a required *Introduction to Aerospace Engineering* course**
- 2. One-semester systems engineering course at the undergraduate level**
 - Serves as prerequisite (junior year) to a senior aerospace design classes (aircraft and spacecraft / mission design)**
 - Use NASA missions and experience base to provide examples / case studies for SE topics**
 - Part of aerospace engineering required curriculum, but could be used as a design course by students in other engineering majors**



SE Curriculum Options (2/2)



Graduate

- 1. One-semester systems engineering course at the graduate level**
 - Adapted from the undergraduate course

- 2. Master of Science in Systems Engineering Program**
 - Professional engineer / life-long learning approach & format and / or intensive on-campus year of study (courses & report)
 - Full-time student / thesis option

Additional Considerations:

- ◆ **Make SE Masters program available to multiple engineering disciplines, not just aerospace**

- ◆ **Capitalize on specialties across university disciplines, such as business school, public policy, engineering management**

- ◆ **For full-time MS program, consider including internships as part of the program requirements (at Gov't installations as well as industry)**



Timetable (1/2)



- ◆ **Ms. Guerra's current assignment is for two years, with intentions to extend to four years.**
- ◆ **Year 1: 2006-2007**
 - **Survey current SE courses, programs, teaching materials, textbooks**
 - **Develop the undergraduate curriculum for Fall '07 schedule**
 - **Scope the content for the MS program**
- ◆ **Year 2: 2007-2008**
 - **Implement the undergraduate SE course(s) at UT Austin as pilot program**
 - **Develop course content for MS program**
 - **Determine implementation options**



Timetable (2/2)



Focus for Ms. Guerra's second term of assignment:

◆ **Year 3: 2008-2009**

- **Implement MS program at UT Austin as pilot program**
- **Coordinate MS program with JSC**
- **Evaluate undergraduate SE course / materials**
- **Make the undergraduate SE materials available to Space Grant Universities**

◆ **Year 4: 2009-2010**

- **Evaluate MS program at UT Austin as pilot program**
- **Enable coordination between UT Austin MS program (options) and JSC**
- **Make the *graduate* SE materials available to Space Grant Universities**



Candidate Course Topics in Systems Engineering



- ◆ **Fundamentals of engineering management**
- ◆ **Project life cycle: from concept to operations to disposal**
- ◆ **Requirements development / operational concepts / understanding the stakeholder**
- ◆ **Risk analysis / risk management & mitigation / knowledge feedback & loss**
- ◆ **Engineering design methodology**
- ◆ **Systems analysis and modeling / design trade studies**
- ◆ **Verification and test**
- ◆ **Safety / reliability / mission assurance**
- ◆ **Cost and schedule estimation and analysis**
- ◆ **Social acceptability: environmental impacts, nuclear safety launch approval, planetary protection**
- ◆ **Large scale simulation**



Next Step



- ◆ **Survey of Existing Systems Engineering Programs and Courses across the US**
 - **Key faculty**
 - **Program details and history**
 - **Course syllabi**
 - **Focus and content**
 - **Resources**
 - **Graduates and where they go**
 - **Other**



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