MBSE Programs at UAH and Other Thoughts

*Presented at the*

**MBSE and Software System Safety Workshop**

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Complex Systems Integration Environment

• Changes in technology are occurring much faster than changes in standards and methods of compliance

• As systems become more complex, traditional systems engineering, contracting methods and airworthiness processes and standards
  – May not be sufficient to ensure safety of the platform while supporting the acquisition process throughout the lifecycle
  – Can drive weight into the design as well as cost without significantly improving the safety and mission effectiveness of systems
  – Try before you build – Virtual prototyping of technology while assessing system level performance

• The acquisition process must clearly articulate the buyers intent in terms of mission effectiveness and capability in order to
  – Create affordable systems and understand the trade space
  – Better assess cost and schedule risk starting at source selection through airworthiness determination and fielding
Early Problem Identification in the Materiel Development Process

- **Requirements Engineering**
- **System Design**
- **Software Architectural Design**
- **Component Software Design**
- **Code Development**
- **Unit Test**
- **Integration Test**
- **System Test**
- **Acceptance Test**

**Legend**

1st Value – Percentage of faults introduced
2nd Value – Percentage of faults found
3rd Value – Estimated cost for fault removal

**Sources:**
Where is the “State of Practice” within Government and Industry on this Roadmap??
RSESC Complex Systems Integration Lab (CSIL)

• The CSIL at UAH provides the necessary environment for
  – Providing the necessary synchronization required between Trade Studies (Technology Push) and Systematic Operations Analysis (Technology Pull)
  – Executing the IPPD tradeoff methodology leveraging existing tools available from S&T and other efforts
  – Integrating new tools and methods as they become available
  – Integrating a broad range of tools into a singular environment
  – Providing the necessary methodology and stakeholder environment for successful FVL AoA execution

• ISEEM faculty, GRA and student engagement has grown significantly with the initiation of MBSE coursework and projects

• Provides a local and low-cost location for Government and industry collaboration necessary to support decision making throughout the Acquisition Process

• Early development of restricted area for classified efforts
Current Research Projects involving MBSE

- NASA – Nuclear Thermal Propulsion (w/Propulsion Research Center)
- PM Utility – UH-60M Improved System Safety (Lightweight FBW)
- PM Apache - Ground Fire Acquisition Demonstration (GFAD) Capability Integration Investigation on the AH-64E Apache
- AMRDEC SED - Architectural Analysis and Design Language (AADL) Graphical Editor for OSATE
- Industry – Support for AADL Algorithm Development
- Industry – Other Classified Projects
- Proposals Pending
  - Aircraft Carrier Overhaul Process Model
  - FVL support for MSAD AADL Improvements
- Additional Industry Focused Projects in Work
Planned Focused Areas

• Program Management Dashboards
  – Utilize one model
  – Entities get updates on status for their respective area
  – Begins with the development of the Acquisition Strategy and SEP

• Cost Capability Analysis
  – Evolving requirements from OSD
  – Already required for Air Force Projects
  – Impossible to do with a schedule and a spreadsheet

• Integration of Safety Products with Requirements Development
  – Integrated FHA and FTA like products that align with model development
  – Safety requirements and traceability integral model development
  – Includes software and hardware
Curricula Status

• Systems Engineering Modeling
  – Course offered in previous semester (Fall ‘16)
  – 11 students (1 senior undergraduate, 10 graduate)

• Development of Complex Systems Models
  – Course offered in current semester (Spring ‘17)
  – Course objective will be development & simulation of a complex system model
  – 6 students enrolled
  – Student projects with RSESC, PEO Aviation & NASA MSFC

• Planned curricula improvements
  – Revised sequence of topic coverage for next offering of SE Modeling (Fall ‘17)
  – Include objective of preparing students for OMG SysML certification
  – Better support for tool use (Cameo Enterprise Architecture)
Recent Publications

• “Virtual Systems Integration using Model Based Systems Engineering”
  – Co authored by Dale Thomas & Bryan Mesmer

• “Integrated System Modeling in SysML for Small Satellites”
  – Authored by Lloyd Walker & Dale Thomas
  – Presented in MST-17, Modeling and Simulation Integration and Architectures, January 12, 2017

• “Human Mental Models and Their Effects on Human and System Interactions within Socio-Technical Systems”
  – Co authored by Elizabeth Patterson & Dale Thomas
  – Presented at 15th CSER, March 23-25, 2017

• “Nuclear Thermal Propulsion Modeling Using Model Based Systems Engineering”
  • Co authored by Alexander Aueron & Dale Thomas
  • To be presented at JANNAF In-Space Chemical Propulsion Technical Interchange Meeting, 4-6 April 2017.
Questions