Systems Engineering Expert Knowledge: SEEK

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Human Capital Development:
Systems Engineering Expert Knowledge (SEEK)

Summary:
Develop a series of case studies tailored to defense education needs to support instruction at the Defense Acquisition University, the Naval Postgraduate School, and other government education and training providers.

Funding: Received for FY14-15

Impact: None to date. Projected impact is improved SE education and training that incorporates actual lessons learned from recent DoD projects, that in turn improves the practice of SE in DoD.

Status:
Initial coordination complete with DAU
• determined stakeholder needs;
• defined interoperability requirements so that the cases can support both DAU and NPS, as well as other users.
Initial topics selected and coordination/data collection underway with data holders.
Loss of experienced people

Engineering Challenges

Source: AT&L Acquisition Workforce DataMart, Dec 2011
Distribution Statement A – Cleared for public release by OSR on 02/19/13; SR Case # 13-S-#### applies.
Value Proposition

The case studies to be produced:

• Are useful for educators and trainers, and are an important part of experience acceleration [5].

• Will integrate into the Systems Engineering Body of Knowledge (SEBoK) [6] – allowing the content to be classified into a widely accepted taxonomy and to support the principles identified in the SEBoK.

• Will complement DAU course modules, and other systems engineering instruction.

• May represent a significant part of the ROI for failed projects.

In some cases, shorter vignettes will be developed instead of full case studies.

• Balancing utility with thoroughness
Related Work

System engineering case studies are not new, but existing studies don’t cover all domains of interest and contemporary practices.

**We currently lack an infrastructure to capture and retain lessons learned about system engineering successes and challenges.**

- The Air Force Institute of Technology published a set of case studies between 2004 and 2008 that focused on Air Force systems, including the C5, F111, Global Positioning System, and Hubble Space Telescope [1].
  - With the closure of the AFIT Center for Systems Engineering in 2012, no further case studies in that series are planned.

- NASA has a catalog of over 50 case studies, focused on spacecraft lift and payloads [2].

- A small number of programs have been the focus of isolated case studies: E.g., General Dynamics published a case study on the Virginia Class Submarine Program, as did Rand [3,4].

- But generally, there are few published case studies for land or sea systems.

- DAU’s Living Library initiative captured, through 2008, lessons learned via video interviews from retiring System Engineering / System Acquisition personnel.
Criteria for Program Selection

- Large scale (ACAT 1 or 2)
- Completed through T&E
- Relevant to current R&M practices
- Have available data
- Multiple services/domains
- Illustrative of a variety of R&M challenges: e.g., hardware, software, personnel, process, etc.
  - Especially software
- Balance successes with challenges
Targeted Programs (Priority Order)

• Expeditionary Fighting Vehicle
  Marine Corps

• Trident D5 Service Life Extension
  Navy

• GPS block 3 upgrade
  multi-svc.

• Future Combat Systems
  Army

• F-22
  AF

• Broad Area Maritime Surveillance
  Navy
  Unmanned Aircraft System

• Advanced Field Artillery Tactical Data System
  Army / Navy

• Multi-band terminal (NMT)
  Navy
## Case Study Topic

<table>
<thead>
<tr>
<th>Case Study Topic</th>
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<tbody>
<tr>
<td>Development Planning and Early Phase Systems Engineering</td>
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<tr>
<td>Eliciting, Developing, and Analyzing Requirements</td>
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<tr>
<td>Identifying an Affordable Design, SE Affordability Trade-off Analysis</td>
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<td>Designing, Producing, and Sustaining Reliable, Maintainable, and Supportable Systems</td>
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<td>System Assurance and Program Protection</td>
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<td>Controlling Cost Throughout the Product Life-Cycle</td>
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<td>Transition to Production and Deployment</td>
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<td>SE in Rapid Acquisition; Tailoring SE processes</td>
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<td>Understanding Industry and Business Acumen</td>
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<td>Planning, Managing, and Leading Technical Reviews</td>
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<td>SE in Sustaining and Supporting Complex Systems</td>
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### Mapping System Artifacts to DAU Learning Objectives

<table>
<thead>
<tr>
<th>TLO</th>
<th>Artifact Given or Role Assigned</th>
<th>Action</th>
<th>Topic 1 Planning</th>
<th>Topic 2 Design</th>
<th>Topic 3 Monitor</th>
<th>Topic 4 Reviews</th>
<th>Topic 5 T&amp;E</th>
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<tbody>
<tr>
<td>EMD 4.1</td>
<td>EMD Integrated test plan</td>
<td>Evaluate</td>
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<tr>
<td>EMD 7.1</td>
<td>EMD R&amp;M Test results</td>
<td>Evaluate</td>
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<tr>
<td>EMD 7.2</td>
<td>Contractor's alternative decisions</td>
<td>Evaluate</td>
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<tr>
<td>EMD 8.1</td>
<td>R&amp;M test results</td>
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<tr>
<td>EMD 8.2</td>
<td>Failure Reporting and Corrective Action System (FRACAS),</td>
<td>Evaluate</td>
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<tr>
<td>EMD 10.1</td>
<td>Government system test plan, procedures and test results</td>
<td>Evaluate</td>
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<td>EMD 13.1</td>
<td>Contractor R&amp;M test plans</td>
<td>Evaluate</td>
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<tr>
<td>EMD 13.2</td>
<td>R&amp;M test plan evaluation results</td>
<td>Provide Input</td>
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<td>EMD/MCR 1.1</td>
<td>R&amp;M results achieved during the EMD Phase</td>
<td>Evaluate</td>
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<td>EMD/MCR 1.2</td>
<td>Milestone C Review Overview - concluding EMD Phase</td>
<td>Recognize</td>
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<td>MSA 2.1</td>
<td>MSA Phase Government R&amp;M program planning</td>
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<td>MSA 4.1</td>
<td>System R&amp;M requirements analysis</td>
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<td>MSA 4.2</td>
<td>System description, operational factors and configuration identification</td>
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<td>MSA 4.3</td>
<td>Evaluation of R&amp;M objectives documented in the ICD and</td>
<td>Recommend</td>
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<td>MSA 6.1</td>
<td>Trade Study</td>
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<td>MSA 7.1</td>
<td>Defense Acquisition System MSA major deliverables</td>
<td>Evaluate</td>
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<tr>
<td>MSA 10.1</td>
<td>Test and Evaluation Master Plan (TEMP)</td>
<td>Evaluate</td>
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**MSA 10.1:** Given a Test and Evaluation Master Plan (TEMP), learner will evaluate the Reliability and Maintainability (R&M) inputs defining how R&M will be tested and evaluated in the associated acquisition phase.
Targeted Data Sources

- Interviews with key government and contractor stakeholders.
- Technical assessments, program history, milestone review data
- EVM and other cost / effort progress measures
- Cost performance
  - Cf. “Performance of the Defense Acquisition System” annual reports from Mr. Kendall’s office
- DOT&E results
Deliverables

• Case studies will include supporting video materials and could be delivered in two formats: one in the public domain in a PDF form with all permissions secured for distribution and a second version for internal DoD use.

• Case studies will include supporting technical documentation.

• The deliverables will be integrated into the SEBoK and be available to Defense Acquisition University and other venues such as the INCOSE SE Handbook.

• The SEEK researchers will also make presentations and publish papers to increase awareness and impact of the research.
Challenges

• Proprietary data

• Reluctance to share the bad and the ugly

• Fostering a culture that values honest, quick, and non-attribitional feedback (a la mishaps in aviation and peer review in medicine)
Questions and discussion

• We would be very interested in hearing about:
  
  — Potential case study users
  
  — Suggestions on data and other sources of program insight

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References


References

