SET Program Overview

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Goals:
- Build awareness of the SET Roadmap
- Determine top SET areas for future research

Agenda:
- Present Research Summary  – 25 minutes
- Brainstorm Areas of Interest  – 20 minutes
- Evaluate Ideas  – 40 minutes
- Summarize Results  – 5 minutes
Problem Statement:

Traditional Systems Engineering (SE) is not adequate to meet the challenges or today’s net-centric, information-based environments and threaten SE with a loss of relevancy. Requiring elaborate documentation, detailed requirements definition, and static long term plans are all ineffective in these environments and counter-intuitive to the technologists working in this domain.

Program Goal:

Transform the discipline of SE to meet the emerging challenges and increase its relevancy.
### SE Approaches

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<thead>
<tr>
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<th>Industry</th>
<th>Optimal</th>
<th>Leverage</th>
<th>Shortfalls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional SE</strong></td>
<td>Defense &amp; Aerospace</td>
<td>Large, <em>mission critical</em></td>
<td>Formal Reviews, Text based documentation</td>
<td>Inflexible, overwhelmed by complexity</td>
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<tr>
<td><strong>Agile Processes</strong></td>
<td>Software</td>
<td>Small, opportunistic</td>
<td>Small, integrated teams, constant communication</td>
<td>Inability to scale, mission critical issues</td>
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<tr>
<td><strong>Electronics</strong></td>
<td>Computer, Networking, Games</td>
<td>Large, mission critical</td>
<td>Technology, tool automation</td>
<td>Domain specific</td>
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- No ‘one-size fits all’ solution
- No existing approach appropriate for the rapid fielding of complex systems

* ‘mission critical’ refers to the need for key safety, reliability, availability aspects
  – NOT importance of capability
Summary of Gaps & Opportunities

- **Cycle Time Reduction** – A suite of processes and tools, including those noted above, which can increase the quality of the systems while compressing latency through the life cycle; these include tools which not only accelerate new development, but also eliminate unnecessary work such as facilitating reuse and providing correct by design construction.

- **Legacy Integration** – the capability to monitor and characterize the current legacy system to ensure that the addition of new applications and services have the desired capabilities, and the ability to integrate independently evolving components into a larger interoperable system.

- **Risk/Opportunity Management** – tools which can assist in the assessment of program risk and value creation to allow for the proper tradeoffs between these competing goals based on the capabilities of the organization and the challenges of the system under development.

- **Human Aware/Self-Adaptive** – the capability to optimize the use of humans in the system to take advantage of self-adaptive human capabilities.

*Ubiquitous Attribute*
Future State

Analysis Driven
- Predictable, Linear

Empirical Feedback Driven
- Opportunistic, Non-Linear

Problem Cannot be solved by “doing the same thing faster” (i.e., scale)!
SET Research Areas

1. Prioritization & Tradeoff Analysis

2. Concept Engineering

3. Architecture & Design Analysis

4. Design & Test Reuse & Synthesis

5. Active System Characterization

6. Human-System Integration

7. Agile Process Engineering

8. Modeling Environment Infrastructure

- Value Models
- Conceive
- Develop
- Use

- Value
- Conceive
- Design
- Full-System
- Deployment
- Use & Maintain
Prioritization and Tradeoff Analysis

![Graph showing prioritization and tradeoff analysis](image)

- **Cost (SM)** vs. **Development Time (Months)**
- Lines represent different RELY, MTBF (hours) scenarios:
  - (RELY, MTBF (hours))
    - (VL, 1)
    - (L, 10)
    - (N, 300)
    - (H, 10K)
    - (VH, 300K)

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- O -- Cost/Schedule/RELY: pick any two” points
Concept Engineering

Portfolio of Canned Scenarios

Graphical interface to allow interactive, collaborative creation of modular CONOPS model

DOTMLPFP Simulator

Cause & Effect Analysis

Customizable Presentation of Results
Visualizations of the entire architecture of a developing system so that the full impact of proposed changes and updates to the system can be anticipated despite system complexity.

- one visualization option could be as a “terrain” where fault-lines represent system fragility.
Design and Test Reuse and Synthesis

Software Reuse

Source: http://sabertooth-interactive.com/images/reuse_diagram.jpg

Source: http://xlr.sourceforge.net/concept/top.html
Active System Characterization

1. Structure
2. Behavior
3. Requirements
4. Parametrics

5. Active System Characterization

HSI methods need to address both the full SE life cycle and dynamic system adaptation contexts.
Based on surveys of govt and commercial entities already working on agile systems engineering

Initial results proved useful for:
- Identification of gaps where MPTs currently missing
- Teams trying to implement agility
- Reasoning about contributions of MPTs to project success
8. Modeling Environment Infrastructure

1. Prioritization & Tradeoff Analysis
2. Concept Engineering
3. Architecture & Design Analysis
4. Design & Test Reuse & Synthesis
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6. Human-System Integration
7. Agile Process Engineering

Model & Data Repository, Simulation & Communication

Virtual

Physical
1. Tradeoff Analysis
2. Concept Engineering
3. Architecture & Design Analysis
4. Design & Test Reuse & Synthesis
5. Active System Characterization
6. Human-System Integration
7. Agile Process Engineering
8. Modeling Environment Infrastructure
<table>
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<tr>
<th>Benefit</th>
<th>Near Term (1 - 2 years)</th>
<th>Middle Term (3 - 5 Years)</th>
<th>Long Term (5+ Years)</th>
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Recommendations

1. ...
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