Surveying Systems Engineering Effectiveness

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Background

Case studies have shown that properly implemented systems engineering can result in commensurate benefits.

Broadly applicable quantification of these costs and benefits remains elusive.

- Complicated by the lack of a broadly accepted definition of Systems Engineering.
- Insufficient identification and tracking of Systems Engineering costs and efforts.
- Exacerbated by increasing complexity and size of systems and Systems of Systems.
The Task

The Office of the Under Secretary of Defense (AT&L) has tasked the NDIA Systems Engineering Division to research and report on the costs and benefits associated with Systems Engineering practices in the acquisition and / or development of military systems.

The Systems Engineering Effectiveness Committee (SEEC) is addressing this task via a survey of program and project managers across the defense industry.
Survey Objective

Identify the degree of correlation between the use of specific systems engineering practices and activities on projects, and quantitative measures of project / program performance.

Survey Method

Use the resources of NDIA SE Division to reach a broad constituency

The initial survey will focus on industry members of NDIA that are prime contractors and subcontractors

Collect feedback from project / program managers
Survey Development Plan

- Define the goal
- Choose the population
- Define the means to assess usage of SE practices
- Define the measured benefits to be studied
- Develop the survey instrument
- Execute the survey
- Analyze the results
- Report
- Plan future studies
Step 1: Define the Goal

Identify correlations between SE practices and program performance

Step 2: Choose the population

Chosen population consists of contractors and subcontractors providing products to the DoD
Step 3: Define assessment of SE practices

CMMI-SW/SE v1.1
- 22 Process Areas
- 157 Goals
- 539 Practices
- 402 Work Products

Systems Engineering Filter
- 13 Process Areas
- 27 Goals
- 75 Practices
- 185 Work Products

Size Constraint Filter
- 10 Process Areas
- 19 Goals
- 34 Practices
- 63 Work Products
Step 4: Define performance measures

Utilize measures common to many organizations

• Earned Value
• Award Fees
• Technical Requirements Satisfaction
• Milestone Satisfaction
• Problem Reports
Step 5: Develop the survey instrument

Self-administration
• formatted for web-based deployment

Confidentiality
• No elicitation of identifying data
• Anonymous response collection
• Responses accessible only to authorized SEI staff

Integrity
• Data used only for stated purpose
• No attempt to extract identification data

Self-checking

Section 1
Project Characterization

Section 2
Systems Engineering Evidence

Section 3
Project / Program Performance Metrics
Section 1 - Characterization

Characterization of the project / program under consideration

• **Project / program**
  - Size
  - Stability
  - Lifecycle phase
  - Subcontracting
  - Application domain
  - Customer / User
  - etc.

• **Organization**
  - Size
  - Organizational capability
  - Related experience
  - etc.

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**Section 1: Characterization**

The objective of this section is to gather information to characterize the project under consideration. This information will assist the survey analysts in categorizing the project, and the executing organization to better understand your responses.

1.1 **Project** – information to characterize the specific project under discussion. Size, stability, lifecycle phase, subcontracting, and application domain are among the parameters used for program characterization.

1.1.1 What phases of the integrated product lifecycle comprise this project (check all that apply), and what phase are you presently executing (check 1)?

- Concept Refinement
- Technology Development and Demonstration
- Development
- Manufacturing
- Verification
- Training
- Deployment
- Operation
- Support
- Disposal

1.1.2 What is the current total contract value (US$) of your project? $ __________

1.1.3 What was the initial contract value (US$) of your project? $ __________

1.1.4 How many contract change orders have been received? __________________
## Section 2: SE Evidence

Process definition  
Project / program planning  
Risk management  
Requirements development  
Requirements management  
Trade studies  
Interfaces  
Product structure  
Product integration  
Test and verification  
Project / program reviews  
Validation  
Configuration management

### Section 2: Systems Engineering Evidence

<table>
<thead>
<tr>
<th>Rate your agreement with the following statements</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Process Definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1.1 This project utilizes a documented set of systems engineering processes for the planning and execution of the project</td>
<td>r r r r</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 Project Planning</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2.2.1 This project has an accurate and up-to-date Work Breakdown Structure (WBS) that...</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>a. includes task descriptions and work package descriptions</td>
<td>r r r r</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>b. is based upon the product structure</td>
<td></td>
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</tr>
<tr>
<td>c. is developed with the active participation of those who perform the systems engineering activities</td>
<td></td>
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</tbody>
</table>
Section 3: Performance Metrics

Earned Value
Award fees
Technical requirements satisfaction
Milestone satisfaction
Problem reports

Section 3: Project Performance Metrics

<table>
<thead>
<tr>
<th></th>
<th>Earned Value Management System (EVMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate your agreement with the following statements</td>
</tr>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>3.1.1</td>
<td>Your customer requires that you supply EVMS data?</td>
</tr>
<tr>
<td>3.1.2</td>
<td>EVMS data is available to decision makers in a timely manner (i.e. current within 2 weeks)?</td>
</tr>
<tr>
<td>3.1.3</td>
<td>The requirement to track and report EVMS data is levied upon the project’s suppliers.</td>
</tr>
<tr>
<td>3.1.4</td>
<td>Variance thresholds for CPI and SPI variance are defined, documented, and used to determine when</td>
</tr>
</tbody>
</table>
Step 6: Execute the survey

Identify Industry Members focals
Contact focals, brief the survey process, solicit support
Provide web access data to focals
Expedit response
Expedit response
Report* findings to NDIA and OSD

Identify respondents and report # to SEI
Solicit respondents and provide web site access info
Expedit response
Expedit response
Report # of responses provided to SEI

Complete questionnaire and submit to SEI
Report completion to focal.

Collect responses and response rate data
Analyze data and report to SEEC

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Step 7: **Analyze the results**

Partition responses based on project characterizations

Analyze survey responses to look for correlations between the SE practices and the chosen metrics.

Step 8: **Report**

Summarize survey results and analysis in a report.

Step 9: **Plan future studies**

Based upon the findings from the survey, the need for additional studies may be defined.
**Status**

Survey instrument development complete
Web deployment complete
Respondent identification in progress
Response collection through Nov.
Analysis through Dec. and Jan.
Report in Feb.
SE Effectiveness Committee

Dennis Ahearn       Marvin Anthony       Ben Badami
David P. Ball       Al Brown*            Al Bruns
Thomas Christian    Jack Crowley         John Colombi
Greg DiBenedetto    Jim Dietz            Brian Donahue
Terry Doran         Joseph Elm           John P. Gaddie
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Rex Sallade         Jay R. Schrand       Sarah Sheard
Jack Stockdale      Jason Stripinis      Mike Ucchino*
Ruth Wuenschel      Brenda Zettervall   

* co-chair
Conclusion

Contact information
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THANK YOU
Target Audience

• AAI Corp.
• Alion Science & Technology
• Allied-Signal
• Anteon Corp
• AT&T
• BAE Systems
• BBN Technologies
• Boeing
• Computer Sciences Corp.
• Concurrent Technologies Corp.
• DCS Corp.
• DRS Technologies
• Foster-Miller Inc.
• GE
• General Dynamics
• Gestalt, LLC
• Harris Corp.
• Honeywell
• Hughes Space & Communications
• Impact Technologies LLC
• ITT Industries
• Jacobs Sverdrup
• L-3 Communications
• Lockheed Martin
• Motorola
• Northrop Grumman
• Orbital Sciences Corp.
• Raytheon
• Rockwell Collins
• SAIC
• Scientific Solutions, Inc.
• SI International
• Simulation Strategies Inc.
• Southwest Research Institute
• SRA International
• Support Systems Associates Inc.
• Systems & Electronics, Inc.
• TERADYNE, Inc.
• Titan Systems Co. (AverStar Group)
• Trident Systems, Inc.
• TRW Inc.
• United Defense LP
• United Technologies
• Virtual Technology Corp.
• Vitech Corp.

Selection criteria: Active in NDIA SED

Contractors delivering products to the government

Need Point-of-Contact (Focal) from each company to expedite survey deployment.