Systemic Analysis of Software Intensive System Issues

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Tri-Service Assessment Initiative Systemic Analysis™

Overarching Questions …

• How are software related problems impacting overall DoD program performance?

• Why do we always seem to be trying to solve the same problems again and again?

• How do we really improve? Do we know where to start?

• Are we focusing on the symptoms or the causes of our performance issues?
Tri-Service Assessment Initiative Initiative

- **TAI Initiated by OSD in 1998 to address repeated performance shortfalls attributed to software**
  - Integrate independent program assessments into standard acquisition practice to help improve program performance

- **In May 2000, the Defense Science Board recommended independent assessments for all ACAT I-III programs**

- **Independent Expert Program Review (IEPR) Policy**
  - Initially included in DoD 5000.2
  - Now addressed in FY03 Defense Authorization Act, Section 804 Improvement of Software Acquisition Processes - acquisition evaluation and improvement requirements
Tri-Service Assessment Initiative Systemic Analysis™

Tri-Service Assessment Initiative™

- Individual Program Assessments
  - Independent Expert Program Reviews (IEPR)
  - Single Program Focus
  - Objective - Improve Program Performance

- Systemic Analysis
  - Cross-Program Analysis
  - Enterprise Focus
  - Objective - Identify and Characterize Recurring Performance Factors

TAI Activities are based on an Integrated Assessment Architecture
Systemic Analysis

- Identifies recurring program performance issues, risks, and problems
- Quantifies the extent to which these issues are observed
- Determines the cause and effect relationships between identified program performance issues
- Allocates issue responsibility within the DoD acquisition management structure
- Program scope - software focus
**Tri-Service Assessment Initiative Systemic Analysis™**

**TAI SA Process**

**Assessment Products:**
Reports, Briefings, CE diagrams

**Systemic Analysis**

"Products"
- Triggers/Symptoms
- Systemic Issues
- Responsibilities
- Frequencies
- Patterns

**Systemic Analysis**

"Products"

- **Triggers/Symptoms**
  - Over budget
  - Late
  - Poor Product Quality
  - Miscommunication
  - Costly Technology
  - Refresh
  - Poor Morale
  - No Product Line
  - Architecture
  - Poor Interoperability
  - Rework

- **Systemic Issues**
  - High Turnover Rate
  - Staff Burnout
  - Inadequate Staff
  - Insufficient Funding
  - Poor Technical Decisions
  - Incomplete Requirements
  - Incomplete Testing
  - No robust Design
Assessment Distribution

**Distribution of Assessments by Service**

- Navy: 39%
- Air Force: 9%
- Army: 30%
- Joint: 13%
- Other: 9%

**Distribution of Assessments by ACAT Level**

- N/A: 9%
- ACAT ID: 26%
- ACAT IA: 9%
- ACAT IC: 4%
- ACAT III: 17%
- ACAT II: 35%

**Distribution of Assessments by Domain**

- Ground/Weapon: 13%
- C4I: 18%
- Missile/Munition: 18%
- Missile Defense: 13%
- Aviation: 13%
- IT: 4%
- Ship/Sub: 13%
- Avionics: 4%
- EW: 4%
Systemic Analysis Executive Summary

- Recurring issues exist across software intensive programs regardless of program characteristics
- They are more prevalent than expected
- Traditional acquisition and development problems have yet to be adequately addressed
- Causative issues produce different performance symptoms in different programs
- Solutions and corrective approaches have been predominantly “stovepiped”
Systemic Analysis Executive Summary

- The gap between “program expectations” and “program performance” is significant across the board
- Many of the causative issues result in inadequate software development performance
- New recurring issues are emerging as DoD acquisition strategies and technologies change
- We continue to focus on fixing the symptoms, not the causes
## Critical Program Performance Problems

<table>
<thead>
<tr>
<th>Identified Issues</th>
<th>Relative Occurrence</th>
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</thead>
<tbody>
<tr>
<td>Process Capability</td>
<td>91 %</td>
</tr>
<tr>
<td>Organizational Management</td>
<td>87 %</td>
</tr>
<tr>
<td>Requirements Management</td>
<td>87 %</td>
</tr>
<tr>
<td>Product Testing</td>
<td>83 %</td>
</tr>
<tr>
<td>Program Planning</td>
<td>74 %</td>
</tr>
<tr>
<td>Product Quality - Rework</td>
<td>70 %</td>
</tr>
<tr>
<td>System Engineering</td>
<td>61 %</td>
</tr>
<tr>
<td>Process Adherence</td>
<td>52 %</td>
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<tr>
<td>Program Schedule</td>
<td>48 %</td>
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<tr>
<td>Interoperability</td>
<td>43 %</td>
</tr>
<tr>
<td>Decision Making</td>
<td>43 %</td>
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<tr>
<td>Configuration Management</td>
<td>26 %</td>
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Issue Responsibility Allocations

Complex issues with multiple interactions across all levels of DoD management

Identified Issues by Responsibility

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Count</th>
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<tbody>
<tr>
<td>Congress</td>
<td></td>
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<tr>
<td>DoD</td>
<td></td>
</tr>
<tr>
<td>Service Level</td>
<td></td>
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<tr>
<td>PM</td>
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<tr>
<td>Systems Engineering</td>
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<tr>
<td>Working Level</td>
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</tbody>
</table>
Issue Responsibility

**Congress** - includes Congressional influence as well as program external environmental factors

**DoD** - includes DoD policy, directives and guidance

**Service** - includes Service level policy, directives and guidance

**Program Manager** - includes all program organic PM-level responsibilities, from both the acquirer and supplier (developer) perspectives

**Systems Engineering** - includes all system engineering-level responsibilities from both the acquirer and supplier perspectives

**Working Level** - includes all the responsibilities of the development staff executing the program-related tasks
Under pressure, Program Managers make trade-off decisions that impact, in order:

- Development progress
- Product technical performance
- Product quality and rework
- System usability
- Cost
Top Level Issue Categorization

Acquisition / Program Management

Systems Engineering

Technical Processes
Analysis Summary

• The current DoD program issue profile shows minimal performance impact from past corrective actions, initiatives, and policy

• The Program Manager and the Development Team must address the majority of the program issues, even if they are caused by Enterprise level decisions or behaviors

• Causative issues multiply downstream

• The Program Team creates many of their own performance problems

• There are no “single issue” program performance drivers or solutions

• Issue interactions are extremely complex
Systemic Findings - Emerging Issues

• Supplier program management and control
• Direct congressional to supplier “plus up” funding
• Massive mission based acquisition and supplier organizations
• Increasing system interoperability and codependency
• Extensive design for mission resiliency
• Fewer and less experienced resources
• Increasing cost consciousness
• Technology integration and update
• CMMI, Evolutionary Spiral, Capability Based Acquisition, Best Practices, others …
Symptom or Cause?

Symptom

Causative Issue

Corrective Action

Unintended Consequences

Quick Fix

Correcting Process

Symptom Correcting Process

Cause Correcting Process

Peter M. Senge
The Fifth Discipline

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Corrective Actions?

- Need to establish performance parameters that can be implemented with success across the life of the program
  - Feasible plan
  - Understood constraints
  - Change tolerance

- Need to improve the capabilities of the development teams
  - Real systems engineering
  - Funded management and technical approaches critical to interoperability
  - Foundational processes reinforced
  - Process capability in addition to process adherence
Corrective Actions?

• Need to ensure that all program stakeholders agree on an integrated strategy for attacking the high priority overarching program issues:
  - Congress and Enterprise
  - Program team
  - Education and technology infrastructures

• Need to augment acquisition policy with:
  - A clear understanding of the complex interactions and constraints that programs are faced with
  - Adequate implementation guidance
  - Directed education
Is there an increasing gap between what is required and what is capable of being achieved?
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