Software Sustainment Challenges in Defense Acquisition

April 2009
AIAA Engineering Conference
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Acquisition cost growth over 11 years (Selected Acquisition Report data FY 1995–2005):
- Estimation changes: $201B
- Engineering changes: $147B
- Schedule changes: $70B

Over the past 10 years, DoD systems have experienced a 33% cost growth due to “RDT&E mistakes”*

DoD IOT&E results, FY2001-2006
- 29 systems; mix of ACAT II, 1C, 1D across 3 Services
- Approx. 50% were deemed “Not Suitable”, or partially NS
- Approx. 33% were deemed “Not Effective”, or partially NE

*Source: DoD Cost Avoidance Study (CAIG) 10 year ongoing
Software Industrial Base Study

**Demand Findings / Conclusions**
- DoD’s dependence on larger, more complex software is increasing the risk of failing to deliver systems on schedule and within budget

**Supply Findings / Conclusions**
- There is a choke-point in the top-tier software program managers, architects and domain experts
  - About 500-600 “elite” individuals in the nation
- Supply of sufficiently trained software developers is inadequate near-term
  - Demand outpaces degrees granted by 2 to 1
  - Software development jobs being filled with staff lacking formal training
- Current and projected enrollment in software-related academic majors will not meet demand
DoD Software Demand
System Size and Complexity

- Findings
  - Increasing dependence on software to deliver capabilities
    \(^1\)
  - As software development gets larger, programs are more likely to fall behind schedule, or get cancelled \(^2\)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Year</th>
<th>% of Functions Controlled by SW</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-4</td>
<td>1960</td>
<td>8%</td>
</tr>
<tr>
<td>A-7</td>
<td>1964</td>
<td>10%</td>
</tr>
<tr>
<td>F-111</td>
<td>1970</td>
<td>20%</td>
</tr>
<tr>
<td>F-15</td>
<td>1975</td>
<td>35%</td>
</tr>
<tr>
<td>F-16</td>
<td>1982</td>
<td>45%</td>
</tr>
<tr>
<td>B-2</td>
<td>1990</td>
<td>65%</td>
</tr>
<tr>
<td>F-22</td>
<td>2000</td>
<td>80%</td>
</tr>
</tbody>
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1. SWIB Phase I citing Defense Science Board
2. Software Productivity Research
DoD’s dependence on larger, more complex software increases the risk of failing to deliver systems on schedule and within budget.
Acquisition Reform

- Mid 1990s
  - Shift to commercial vice military specifications
  - Federal Acquistion Reform Act eliminated 15,000 of the Defense Acquisition Workforce
  - Emphasis shifts from engineering to acquisition
- Systems increased in size and complexity
  - Greater cost, schedule, performance impacts
- 2003 – Revitalization of systems engineering
- 2009 – Updates to acquisition policy
  - Encourages preliminary design reviews prior to start of system acquisition
  - Requires competitive prototyping in technology development
Concurrent Planning, Development and Sustainment

- Software intensive systems encourage:
  - Build-a-little, test-a-little, field-a-little risk reduction
  - Incremental and spiral development efforts
  - Concurrent planning, development and sustainment activities

- No longer a natural ‘break point’ where software development can be transitioned to a sustainment organization
  - Technical capability of Government sustainment organizations reduced due to acquisition reform

- Planning for software sustainment now a lost art
  - Acquisition programs no longer produce MIL-HDBK 347 Computer Resource Life Cycle Management Plans

Better planning needed to partition software work among multiple developers and increase competition
Software technology readiness levels problematic

If software is left to be developed, how can it be used in an operationally relevant environment?

Risk reduction may be better focus for software during technology development

Competitive prototyping, preliminary design review during technology development may encourage well-defined software architectures

Government control of architecture allows for competition, e.g., Navy Open Architecture

Allows work to be partitioned among multiple organizations
DoD has two significant software human capital initiatives:

- Graduate Software Engineering Reference Curriculum:
  - Better define what it means to be a software engineer

- Software Acquisition Training and Education Workgroup
  - Define software competencies for the 13 DoD acquisition career fields
Conclusions

- Growing importance of software often:
  - Creates parallel planning, development & sustainment efforts
  - Adds complexity to crafting acquisition strategies that promote competition for software development.

- DoD can enhance competition in software development by emphasizing:
  - Government control of system architectures
  - Better planning for software sustainment

- Shortages of top-tier software engineering talent will likely impact DoD acquisition
  - DoD initiatives to address human capital shortfalls should eventually address these issues
Questions/Discussion