Weapon System Affordability: A CAIG Perspective

Fred Janicki

Director,
Weapon Systems Cost Analysis Division
OSD/PA&E

November 5, 2008
Topics

- Cost growth – a historical perspective
- Why are cost estimates consistently wrong?
- Potential strategies to improve affordability
Cost Growth Trends

Distribution of Total Cost Growth from MS II
Adjusted for Procurement Quantity Changes ¹

Cost Growth Factor by Commodity Class ²

Department of Defense has historically underestimated weapon systems lifecycle costs


Sources of Cost Growth

Contribution to Development Cost Growth by SAR Variance Category
Cost Growth Categories

Avg Growth in MDAP Cost from MS II due to Decisions and Mistakes

- Development
  - Mistakes: 24%
  - Decisions: 21%
- Procurement
  - Mistakes: 18%
  - Decisions: 10%

Cost Growth Categories for 35 Sample Programs
60.0% Net Total Cost Growth (mean values)

## Weapon System Program Cost Growth

<table>
<thead>
<tr>
<th>Programs</th>
<th>Initial Estimate*</th>
<th>Initial Quantity*</th>
<th>Latest Estimate*</th>
<th>Latest Quantity*</th>
<th>Unit Cost Increase</th>
<th>Delay in MS C / IOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Strike Fighter</td>
<td>$177.1B</td>
<td>2,866</td>
<td>$210.0B</td>
<td>2,456</td>
<td>38%</td>
<td>18 / 23 months</td>
</tr>
<tr>
<td>Future Combat Systems</td>
<td>$77.8B</td>
<td>15</td>
<td>$112.4B</td>
<td>15</td>
<td>45%</td>
<td>/ - 56 months</td>
</tr>
<tr>
<td>F-22A Raptor</td>
<td>$64.3B</td>
<td>648</td>
<td>$67.0B</td>
<td>184</td>
<td>194%</td>
<td>7 / 0 months</td>
</tr>
<tr>
<td>Evolved Expendable Launch Vehicle</td>
<td>$13.1B</td>
<td>181</td>
<td>$25.7B</td>
<td>138</td>
<td>157%</td>
<td>No data</td>
</tr>
<tr>
<td>Space Based Infrared System High</td>
<td>$3.7B</td>
<td>5</td>
<td>$9.6B</td>
<td>4</td>
<td>244%</td>
<td>/ - 92 months</td>
</tr>
<tr>
<td>Expeditionary Fighting Vehicle</td>
<td>$8.5B</td>
<td>1025</td>
<td>$13.2B</td>
<td>593</td>
<td>170%</td>
<td>/ - 107 months</td>
</tr>
<tr>
<td>Amphibious Transport Dock Ship</td>
<td>$9.0B</td>
<td>12</td>
<td>$11.5B</td>
<td>9</td>
<td>70%</td>
<td>25 / 35 months</td>
</tr>
<tr>
<td>SSN-774 Virginia Class Submarine</td>
<td>$45.6B</td>
<td>30</td>
<td>$63.8B</td>
<td>30</td>
<td>40%</td>
<td>18 / 17 months</td>
</tr>
<tr>
<td>Armed Recon Helicopter</td>
<td>$3.1B</td>
<td>368</td>
<td>$5.3B</td>
<td>512</td>
<td>20%</td>
<td>27 / 37 months</td>
</tr>
<tr>
<td>ATIRCM/CMWS</td>
<td>$2.8B</td>
<td>2,668</td>
<td>$4.2B</td>
<td>3,589</td>
<td>26%</td>
<td>22 / - months</td>
</tr>
<tr>
<td>Stryker</td>
<td>$8.3B</td>
<td>2,096</td>
<td>$14.3B</td>
<td>3,537</td>
<td>25%</td>
<td>5 / 6 months</td>
</tr>
<tr>
<td>H-1 Upgrade</td>
<td>$2.8B</td>
<td>284</td>
<td>$6.8B</td>
<td>284</td>
<td>142%</td>
<td>55 / 55 months</td>
</tr>
</tbody>
</table>

* Information derived from SARS. All $ in program base year $.
Transportation Infrastructure & Public Works Projects Cost Growth

- Inaccuracy of cost estimates for large rail, fixed link and road infrastructure projects is similar to inaccuracy DoD has experienced
- Like DoD, costs are underestimated in almost 9 out of 10 projects
- Actual costs are 28% higher than estimated costs

DoD is not alone – cost growth affects all large complex projects

Project | CGF
---|---
Big Dig | 2.8
Springfield Interchange | 2.4
DC Metro | 1.9
Boston-Wash DC- NY Rail | 2.3

Why are cost estimates consistently wrong/low?

- Excessive requirements
- Immature technology / COTS integration failures
- Excessive optimism -- highly optimistic schedules & technical assumptions
- Unrealistic planned quantities
- Inflation and direct/indirect rate growth
- Funding instability
- Low initial estimate

Most estimates assume EGAP principle – “Everything Goes According to Plan”
GAO on DOD requirements process

• 1988 GAO Report
  – “On paper, DOD has a reasoned and logical approach for determining its requirements or needs.”
  – “In practice, the available financial resources are insufficient to satisfy all of the identified needs.”
  – Limited funds are spread on all programs
  – PMs have to adjust strategies which causes program instability

• 2005 GAO Testimony
  – “…Our work has shown that DOD’s requirements process generates more demand for new programs than fiscal resources can support. DOD compounds the problem by approving so many highly complex and interdependent programs. Moreover, once a program is approved, requirements can be added along the way that increases costs and risks.”
# Lessons Learned from F/A-22 and F/A-18E/F

<table>
<thead>
<tr>
<th></th>
<th>F/A-22 Lessons</th>
<th>F/A-18E/F Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology Development</strong></td>
<td>Revolutionary technologies and performance increase</td>
<td>Same/evolutionary technologies/performance</td>
</tr>
<tr>
<td><strong>Cost and Schedule Estimates</strong></td>
<td>Initial estimates were unrealistically low</td>
<td>Relatively accurate and stable</td>
</tr>
<tr>
<td><strong>Contractor Teaming</strong></td>
<td>New work distribution. Teaming/workshare may have led to artificial work distribution and caused schedule/cost problems.</td>
<td>Modeled along existing well-defined structure. Lines of responsibility clearly defined.</td>
</tr>
<tr>
<td><strong>Development Concurrency</strong></td>
<td>Concurrent development of state-of-the-art technologies in airframe, engine and avionics</td>
<td>Controlled risk -- existing avionics High Risk avionics development shifted out of the program</td>
</tr>
<tr>
<td><strong>Airframe Weight</strong></td>
<td>Airframe weight data show significant fluctuations indicating significant airframe design instability</td>
<td>Stable design with minor airframe weight increases</td>
</tr>
<tr>
<td><strong>Management Reserve</strong></td>
<td>Very little management reserve to cover design risks</td>
<td>Sufficient reserve to cover unforeseen problems</td>
</tr>
<tr>
<td><strong>Unit Cost Increase</strong></td>
<td><strong>194%</strong></td>
<td><strong>33%</strong></td>
</tr>
</tbody>
</table>

Optimism

delusions of success: how optimism undermines executives’ decisions

“When forecasting the outcomes of risky projects, executives all too easily fall victim to what psychologists call the planning fallacy. In its grip, managers make decisions based on delusional optimism rather than rational weighting of gains, losses and probabilities. They overestimate benefits and underestimate costs. They spin scenarios of success while overlooking the potential for mistakes and miscalculations.”

• Why?
  – Plans developed through Rose-Colored Glasses (cognitive bias)
    • Most people are highly optimistic, think that have more control over events than reality and think they are better than they really are
  – Decision making tends to accentuate the positive (organizational bias)
    • Proposal starts with optimistic assumptions (anchoring)
    • Ignore or underestimate impact of outside rivals or potential mistakes
    • Competition internal resources causes an emphasis on potential benefits (organizational pressure)

• Balanced solution - use historical analogs or “take the outside view”
  – Bypasses cognitive and organizational biases
  – Benefits more pronounced for initiatives that companies have never attempted
  – Too often is ignored as overly pessimistic
  – Results are normally optimistic, but significantly more realistic
Optimistic Schedules

RDT&E TY$M

Dec07
Sep05
Dec02
Sep01
MSII Baseline Oct96

Baseline schedule is severely optimistic
- Schedule driven
- Engineering review (e.g. PDR, CDR) schedule optimistic
- COTS / OTS

Replan still optimistic
- Schedule remains optimistic
- Assumes nothing “goes wrong”
- Little staff for engineering changes

CAIG Forecast
- Event driven schedule
- Appropriate staffing for engineering changes, support of test

SDD Schedule Impact On Staffing

Months after contract award

Head count (FTEs)
Optimistic Schedules

- Dec 99
- MSII Baseline
- Dec04
- Dec07

RDTE & T$M

FY94 FY95 FY96 FY97 FY98 FY99 FY00 FY01 FY02 FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13

SDD Phase

CDP Phase
SDD Staffing Implications

- Department begins many development programs with optimistic schedules
  - The time between engineering reviews are typically compressed
  - System testing is understated and compressed
  - Assumes EGAP – Everything Goes According to Plan

If SDD was planned to less optimistic or event-driven program, the total SDD cost would be reduced
**Are higher estimates a self-fulfilling prophecy?**

Many senior leaders from the Department and Defense Industry believe “cost is a self-fulfilling prophecy.” It is their view that a contractor is highly motivated to find ways to reduce costs if the development contract is negotiated for the lowest possible price. They figure that cost growth will occur, but that the actual cost would be even higher if the contractor was not constrained by the initial low estimates.

An alternate view:

- Low Estimate
- Aggressive Schedule

→

- Insufficient Funding
- Artificial reductions in engineering hours, tests, QC

→

- Design inefficiency & redesign at higher cost

Need “tension on the reins” but realistic estimates may ultimately save resources
Average Annual Growth for Aerospace Costs
1999 to 2007

Total compensation growing much higher than wages and salaries and is driven primarily by health care, insurance and fringe benefits (e.g. pensions)

Data derived from Bureau of Labor and Statics
Potential Strategies to Improve Affordability

- Reduce requirements
- Requirements Growth
  - Reliable definition up front – cost process “forcing function”
  - Monitor growth using realistic cost estimates
- Evolutionary Acquisition
- Use mature technologies
  - Possibly most important factor
- Cost Estimating -- Less optimistic estimate assumptions
- Cost as an Independent Variable (CAIV)
- Budgeting/Programming, Program Management, Contracting
  - Demand/use realistic cost estimates
- Technical And Schedule Baseline
  - Cost/engineering interaction
Other Ideas to Improve Affordability

- Take the outside view
  - Non-Advocate Reviews (NARs)
  - Independent Review Teams
- Source Section RFP Changes
  - Add cost criteria to address difference between the government evaluated “most probable” proposed cost and the offeror’s proposed cost
    - Incentivizes contractors to be less optimistic with proposed estimates
  - Add additional past performance criteria on historical “cost performance” – compare initial contract baseline to final “closeout” contract value
- Add “go/no-go” review after PDR – conduct NARs, update cost estimates and review requirements
Impact of Unrealistic Estimate

- Loss of confidence by Congress
- Funding cuts
- Reduced capability buys
- Capability delivered late or not at all
Benefits to Realistic Strategies

• **Services can plan for realistic IOCs**
  – *Make right calls on budgeting to maintain current system*
  – *Prevents capability gaps*

• **Program Manager**
  – *Better credibility with Congress, OSD, etc.*
  – *Reduced funding variations*
  – *Better ability to manage the program*

• **OSD**
  – *Improves the ability to manage weapon system portfolios*