OBSERVATIONS FROM ROOT CAUSE ANALYSIS

RAND in Support of PARCA

May 2012

Charles Nemfakos
NPS Acquisition Symposium
**Observations from Root Cause Analysis**

**Rand Corporation, PO Box 2138, 1700 Main Street, Santa Monica, CA, 90407-2138**

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**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

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<table>
<thead>
<tr>
<th>a. REPORT</th>
<th>b. ABSTRACT</th>
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**18. NUMBER OF PAGES**
23

**19a. NAME OF RESPONSIBLE PERSON**

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Standard Form 298 (Rev. 8-98)

Prescribed by ANSI Std Z39-18
Performing Root Cause Analysis

• Others have/will cover the enabling legislation, PARCA duties and responsibilities and relationships

• Characteristics of effort
  – Be factual
  – Be concise
  – Be timely

• Requires a multi-disciplinary approach
Analytical Approaches

• Sodium pentothal
• Torture
• What did people say happened (anecdotal)
• Facts from various sources

Consistent with the Express Direction From PARCA We Went with Facts.
“Just the Facts”

• Voluminous amount of material
  – Acquisition databases
  – Budgetary exhibits and justification material
  – Congressional testimony
  – Open sources
  – Interviews

• Mix of classified, proprietary, business sensitive and other data

• Reconciliation is sometimes required.
Analyses Performed

• Root Cause Analyses (both Nunn-McCurdy breaches and others)
  – AB3; Longbow Apache
  – DDG-1000; Zumwalt-Class Destroyer
  – Joint Strike Fighter (with Univ. Tenn. & IDA)
  – Wideband Global Satellite
  – Navy ERP
  – Excalibur
  – JTRS-GMR
  – P8 Aircraft
  – EELV

• Over twenty professional staff applied to this group of program analyses
Root Cause Related

• Examination of Management Issues
  – Nunn-McCurdy Repeaters
  – Nunn-McCurdy Predictions
  – Program Manager Tenure
  – WSARA Law related to Mil Departments
  – Root Cause Knowledge Management
  – Root Cause Global Hawk Modifications
  – Root Cause Framing

Our Perspectives Are Informed By Both
**Program Differences**

- Each of the programs analyzed was different (Kendall’s point on program structure)

- But some common issues pertain

<table>
<thead>
<tr>
<th>Category</th>
<th>Root Cause of Nunn-McCurdy Breach</th>
<th>Apache</th>
<th>DDG-1000</th>
<th>ERP</th>
<th>Excalibur</th>
<th>JSF</th>
<th>WGS</th>
<th>JTRS GMR</th>
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<tr>
<td>Planning</td>
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<td>Within DoD Control</td>
<td>Production delays</td>
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<td>Unanticipated design, manufacturing, or technology integration issues</td>
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- Approach has to be flexible to cover the differing program characteristics and issues involved
RAND Uses an Iterative Approach to Root Cause Analysis (RCA)

Electronic record of data sources and data sources archive

- Verify Cost Data and Quantity Growth
- Reconcile Remaining Issues
- Create the Program Cost Profiles and Pinpoint Occurrences of Cost Growth
- Set Up Long Lead Time Activities
- Document Unit Cost threshold breach
- Verify the Cost Data and Quantify Cost Growth
- Create the Postulates
- Attribute Unit Cost Growth to Root Causes
- Match timeline with Cost Profiles & derive Root Causes of Cost Growth

The Hypothesis

Verify Cost Data and Quantity Growth
Relevant Events from Program History
RAND Important Perspectives From RCA

• Several lessons stand out
  – Need to understand the interrelationship of major modernization programs (FCS)
  – Revolving program management is the antithesis of program stability (F-35)
  – If a program depends upon a commercial base, keep an eye on that base (WGS)
  – For ERPs, distinguish between IT software and business re-engineering as an IT program

• Need to go beyond metrics used generally in acquisition program oversight
Interesting Issues Identified in the Process of Both RCA and Management Questions

• PM Tenure
  – Not identified as a Root Cause
  – An examination across all MDAPs suggest an average of close to 3 years
  – Average tenure is sensitive to calculation methodology

• Financial Stability
  – For major programs resource decisions were driven, not driving

• Multiple Breaches
  – No single reason between programs and across individual program multiple breaches

• Framing Assumptions (Examples)
  – Understanding risk
  – COTS/commercial base
  – Use of simulation
Program Manager Tenure

Note: Each bar represents the average tenure of PMs who started their assignment in that given year.
Populations Demographics
(based on DAMIR since 1997)

- Programs with more than one breach: 23% of those with at least one breach (9% of total)
- Programs with at least one Breach: 39% of total tracked programs
- Programs in DAMIR Past MS B

RAND
Definition and Examples of “Framing Assumptions”

• Framing assumption definition: *Any explicit or implicit assumptions that are central in shaping cost, schedule, and/or performance expectations*

• Unique to a program; not universal to all programs

<table>
<thead>
<tr>
<th>A framing assumption is...</th>
<th>A framing assumption is not...</th>
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<tbody>
<tr>
<td>A unique aspect of contracting strategy (e.g., competitive prototyping)</td>
<td>The contractor will perform well</td>
</tr>
<tr>
<td>Weapon system to be replaced will last until a specified time</td>
<td>Program characteristic (e.g., family of systems)</td>
</tr>
<tr>
<td>Use of COTS / GOTS will save money</td>
<td>Program is affordable</td>
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</tbody>
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Back up
## Identified Framing Assumptions of Past RCAs

<table>
<thead>
<tr>
<th>Technical</th>
<th>Management/Program Structures</th>
<th>Mission Requirements</th>
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<tbody>
<tr>
<td>Reliance on commercial technology increases likelihood of achieving technical program goals. (P-8A, WGS, ERP)</td>
<td>Reliance on commercial initiative/standards insulates the program from risk. (P-8A, WGS, ERP)</td>
<td>Low possibility for emergence of a substitute good. (JTRS)</td>
</tr>
<tr>
<td>Successful sub-system testing predicts overall technical program success. (JSF, Excalibur, AB3, DDG1000)</td>
<td>Threats to program funding are an incentive to manage program risk. (ERP, DG1000, JSF).</td>
<td>Constancy with joint capability requirements (JSF)</td>
</tr>
<tr>
<td>Simulations can substitute for or reduce full scale testing. (JTRS, JSF)</td>
<td>Management changes do not detract from program outlook. (JTRS, JSF)</td>
<td>Reliance on commercial technology shields program allows program to adapt quicker to changing operational requirements. (P-8A)</td>
</tr>
<tr>
<td>New testing/manufacturing approaches can reduce historic number of test articles (JTRS, JSF, P-8A)</td>
<td>Program sub-component/integration risks not a geometric risk function (JSF, AB3, DDG1000, JTRS, Excalibur)</td>
<td></td>
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Apache Breach Root Cause

• Root Cause
  – Quantity increase
    • 58 new build aircraft (100% new) added to retrofit program (30% new)
    • Buy new fuselages; unavailability of airframes

• Major Contributors
  – Immature technologies
    • Incorporate 15 cutting edge technologies
  – Unanticipated design, manufacturing, or technology integration issues
    • Increase in non-recurring engineering costs to reflect post MS B knowledge & experience
DDG-1000 Breach Root Cause

• Root Cause
  – Quantity decrease
    • Reduction from 10 ships at MS B to 3 ships due to affordability issues

• Major Contributor
  – 7 program planning issues contributed to cost growth
  – None were significant individually, but collectively may have been significant
    • Underestimation of baseline cost
    • Ambitious schedule
    • Immature technologies
    • Ill-conceived manufacturing process
JSF Breach Root Cause

• Root Cause:
  – Numerous Immature technologies
    • Complex integration
    • Reliance on unproven innovations to contain program costs
    • Prototype did not demonstrate new technologies

• Major Contributors:
  – Production delays
    • Aggressive and highly concurrent schedule
    • Affordability required fast ramp to high production rates
  – Unanticipated design, manufacturing, and technology integration issues, including weight growth and design issues
Excalibur Breach Root Cause

• Root Cause:
  – Quantity decrease
    • Reduction from 30K to 7K projectiles due to affordability and lack of customer demand

• Major Contributor:
  – Unanticipated design, manufacturing, or technology integration issues
    • Early program cost estimates highly inaccurate and insensitive to reductions in quantity
WGS Breach Root Cause

• Root Cause:
  – Production delays
    • 2.5 year hiatus between Blocks II and III
    • Options allowed to expire; multi-year procurement breaks
    • Storage and restart costs

• Major Contributors:
  – Increase in component costs
    • Commercial marketplace no longer supports WGS systems which have not changed in 10 years
  – Poorly constructed contractual incentives
    • 15% risk premium with limited evidence of risk
JTRS GMR Breach Root Cause

• Root Cause:
  – Quantity fell from 86K to 10K radios
    • Cancellation of FCS
    • Performance issues which reduced the size of the WNW network
    • Emergence of lower cost, lower SWAP alternatives

• Major Contributors:
  – Immature technologies & unrealistic performance expectations
    • “Mobile ad hoc networks” scalability up to 250 nodes assumed, but field experiments only achieved a 30 node network size
  – Unanticipated design issues
    • Demonstrated limitations on network size required a redesign of the network architecture, which employed fewer GMRs
Most of the Significant Root Causes Are Within DoD Control

• Planning and program oversight issues – which are within DoD’s control – are significant root causes of cost growth
  – 5 of 7 RAND analyses identify planning issues
  – All 7 RAND analyses identify program oversight issues

• Only one program (WGS) showed economic issues as a significant root cause of cost growth

• Related root causes can be collectively significant
  – 7 planning issues in DDG case contributed to cost growth though no single planning issue was a significant root cause
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