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ROOT CAUSE ANALYSES OF NUNN-MCCURDY BREACHES

VOLUME 2

Excalibur Artillery Projectile
and the
Navy Enterprise Resource
Planning Program,

with an Approach to
Analyzing Program
Complexity and Risk

Prepared for the Office of the Secretary of Defense

NATIONAL DEFENSE RESEARCH INSTITUTE

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Summary

Background

As a result of continuing program cost growth and observations by the Government Accountability Office (GAO) placing defense acquisition on the high-risk target list, Congress became particularly concerned about the execution of major defense acquisition programs. This concern and the reality of shrinking defense budgets led Congress to enact laws that would increase the focus of senior policymakers on oversight of major defense acquisition programs (MDAPs) and other large costly programs.[2] The Weapon Systems Acquisition Reform Act (WSARA) of 2009[3] established a number of requirements that affected the operation of the Defense Acquisition System and the duties of the key officials who support it, including the requirement to establish a new organization in the Office of the Secretary of Defense (OSD) with the mandate to conduct and oversee performance assessments and root cause analysis (PARCA) for MDAPs.

In March 2010, the director of the PARCA office determined that he needed support to execute his statutory responsibilities and turned to federally funded research and development centers (FFRDCs) and academia to provide that support for the research and analysis of program execution status. RAND was one FFRDC engaged to perform research and analysis and provide recommendations and was originally assigned responsibility for four programs.[4] After completing that initial effort, RAND was assigned two additional programs for research and analysis: Excalibur and the Navy Enterprise Resource Program (ERP).

Purpose

This report does two things. First, it analyzes the root cause of cost overruns in two programs: the Army Excalibur artillery round and the Navy ERP. The Excalibur proj-

[2] Ike Skelton Defense Authorization Act for Fiscal Year 2011, December 20, 2010.

[3] Public Law 111-23, Weapon Systems Acquisition Reform Act of 2009, May 22, 2009.

[4] Blickstein et al., 2011.

ect incurred a Nunn-McCurdy breach. The ERP did not, but the cost growth was so great that the Department of Defense (DoD) requested a root cause analysis.

Second, it presents what can be described as an exercise to help identify the most critical features of a program. Critical program components are those that carry the most risk of overall program failure. The exercise is designed to identify the important program features that decisionmakers would want to concentrate on when inquiring about a program as it develops over time. The report then uses the results of the exercise to flag the most critical features of the weapon system, using Excalibur as an example. The exercise and the illustration help to frame one approach for considering program failure risk in programs that have not yet breached.

Observations on the Conduct of Root Cause Analyses

Each acquisition program is unique, and each root cause analysis (RCA) is unique. However, RAND's experience in conducting six root cause analyses indicates that a set of core activities is instrumental to a successful effort. These activities define a generic root cause methodology whose key components include the following:

- Gather and review readily available data.
- Develop a hypothesis.
- Set up long-lead-time activities.
- Document the unit cost threshold breach.
- Construct a time line of relevant cost growth events in the program history.
- Verify the cost data and quantify cost growth.
- Create and analyze the program cost profiles pinpointing occurrences of cost growth.
- Match the time line events with changes in the cost profiles and derive root causes of cost growth.
- Reconcile any remaining issues.
- Attribute unit cost growth to root causes.

Successful execution of this set of activities should enable the research team to create the primary deliverables and postulates for a root cause analysis: a summary narrative that includes clearly stated root causes of cost growth supported by a formal documentation of the cost threshold breach, a summary time line of program events leading to the Nunn-McCurdy breach, funding profiles, a completed PARCA-office-generated root cause matrix, and a breakdown of the amount of cost growth attributable to each root cause; a briefing that corresponds to the narrative; and a full root cause report.

In addition to developing deliverables and postulates, the RCA process is designed to improve the research focus iteratively. At each stage of the RCA, information is drawn from and contributed to the program archive. The RCA analytic team can use this insight not only to improve the interim products that result from successive stages of the RCA but also to advance the original hypothesis that guides the research. This process of regularly refining the guiding hypothesis with the insight gained during the production of key deliverables and postulates enables the research team to quickly identify the root causes of a program's failure.

Findings of Root Cause Analyses

Excalibur

RAND's root cause analysis identified one primary driver and four contributing factors to Excalibur's Nunn-McCurdy cost breach. The most significant source of cost increase was the *change in procurement quantities*: a 79 percent reduction in the number of Excalibur rounds ordered. The root causes of this quantity reduction were changes in requirements combined with affordability considerations. Specifically, the manner in which artillery was being used and the precision of the Excalibur round meant that fewer would be needed.

An Army review of precision-guided munitions capability placed the required quantity of Excalibur munitions in the context of the other guided munitions in the Army's arsenal, leading to a decision to reduce the Army's procurement objective for Excalibur. The quantity reduction, resulting from changes in perceived requirements, was so large that Nunn-McCurdy unit cost breaches would have occurred even in the absence of any other factor.

Another four factors contributed to some program cost growth before the decision was made to reduce procurement quantity. *Inaccurate cost estimates* contributed to some cost growth. Both the original May 1997 cost estimates and the initial Selected Acquisition Report (SAR) estimates were too low to reflect the technological improvement represented by Excalibur, making an eventual cost overrun more likely. Additional drivers of the cost growth before the breach include a *concept and technological change* that occurred between the original solicitation and the contract award in January 1998, as well as some *minor technical issues* that were identified between 2002 and 2010. Finally, Excalibur unit cost growth was driven by the validated and *urgent operational need for Operation Enduring Freedom/Operation Iraqi Freedom* (OEF/OIF), which caused production to be accelerated and more Increment Ia rounds produced than initially planned.

Excalibur was unaffected by other potential root causes. For example, it lived up to its performance expectations, was not affected by poor government or contractor performance, and had sufficient and fairly stable sources of funding.

Navy Enterprise Resource Planning

Although the Navy ERP program technically breached the Nunn-McCurdy cost growth limits and was implemented behind schedule, the program can be considered a qualified success. The majority of cost growth and schedule delays occurred in 2004 and 2005. Since the 2006 re-baseline, costs have stabilized and production delays have been limited.

Part of the root cause of the 2004 cost overrun was a somewhat *optimistic baseline for cost and schedule*. The greater problem was the *unexpected change in business practices* caused by the Navy's decision, after the Base Realignment and Closure (BRAC) process, to move maintenance from an intermediate-level construct to a regional one. The latter led to the major schedule slippage in 2005 and forced the ERP program to jettison its extension to maintenance activities.

The ERP program was re-baselined in 2006 at $400 million higher. The increase arose from a redesign of the system, a change in business practices, and an improvement in estimates. Since 2006, ERP costs have stabilized and the program has been successfully implemented at three System Commands (SYSCOMs). Minor additional slippage in schedule has occurred primarily as a result of timing issues rather than program delays or failures.

The Navy ERP can be considered a qualified success. Although initial cost growth and schedule slippage were significant, they were not explosive, and the ERP program was never in real danger. Several factors may have contributed to relative program success, including the use of pilot projects, cost-plus contracting, the decision to minimize the customization of the SAP solution, interactive governance and high leadership interest, and a willingness to rely on the managerial and technical expertise of civilian cadres.

Program Complexity

One conclusion drawn from the analysis of the six programs that had Nunn-McCurdy breaches is that key decisionmakers lacked adequate visibility into the programs. After analyzing the programs that breached, it became clear that indications existed that a breach was possible (or even likely), but they were buried in the program documentation. This opaqueness occurs because key details can be hidden in the voluminous documents a program produces or can appear only as elliptical references in program reports. Thinking about how to mitigate this problem, RAND researchers determined that a well-constructed framework could help decisionmakers identify areas where a program might have greater risk for problems (and thus a potential Nunn-McCurdy breach) so that they could direct more management attention to those areas.

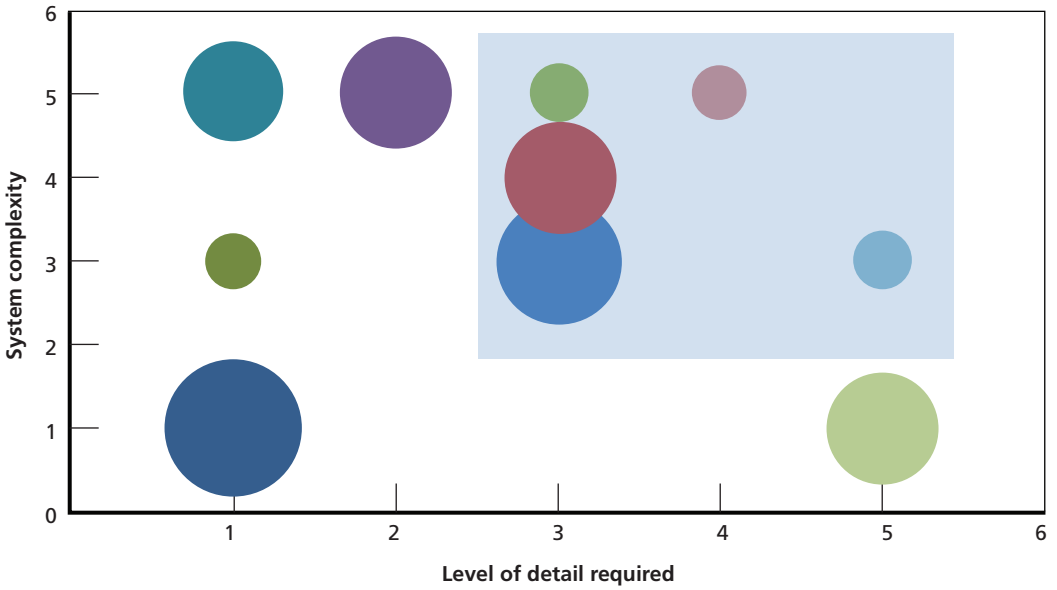
The research team proposed that decisionmakers use a "selective screening of critical components" process to identify the features of most risk to a program. The process

relates measures of merit drawn from a variety of *Jane's* publications used to describe programs to the complexity and level of data detail available for specific program features. A measure of merit is broadly a set of technical components that contribute to a measurable process. An example of a measure of merit pertains to the turboshafts of the Apache helicopter and is described as the "maximum continuous drive" for the platform. Other helicopters and other systems also use the maximum continuous drive measure of merit. The measure includes specific technical components as well as systems of components used to generate a particular level of performance, in this case maximum continuous drive. Researchers developed a graphical display technique to help identify likely areas of risk.

The most important measures of merit for program personnel to consider are the ones that are both highly complex and the least visible. The display in Figure S.1 shows measures of merit that have been coded for level of complexity and detail required (e.g., a more complex system requires more detail).

With this tool, the decisionmaker or analyst can evaluate the frequency of components at various regions of the resultant "complexity-detail matrix" to get a better view of the measures of merit that contain the program features with the most potential risk. Construction of this matrix is an important aspect of the selective screening process. For the Longbow Apache, the shaded blue square highlights the system components that are closer to the upper right corner of the display, i.e., those that are the most complex yet the least visible. These are the ones that warrant greater attention

Figure S.1
Longbow Apache Nominal Example



RAND *MG1171/2-S.1*

from the program managers. Use of common metrics allows programs to be compared across systems.

Program Risk

The project team also developed a methodology to identify technical risk in a program's most critical components early enough to allow project managers to take action to avoid a Nunn-McCurdy breach. The risk experiment explored the Excalibur artillery round. First, researchers went through the process described above to identify the key components, i.e., those on the critical path of program success. For Excalibur, these turned out to be the global positioning system (GPS) and the inertial measurement unit (IMU).

Having identified the critical components of the Excalibur program, the team then turned to Defense Contract Management Agency (DCMA) parts management program (PMP) and Defense Acquisition Executive Summary (DAES) risk assessments to ascertain if either DCMA or DAES presaged the problems. The DCMA reports were issued monthly. Those RAND received covered only 31 months of a 13-year program, but they contained enough data to detect patterns. The DCMA reports use a stoplight system to highlight risk for technical components. The DAES risk assessments are periodic summaries provided to the Defense Acquisition Executive.

Review of the DCMA reports showed that the summary-level judgments assessed moderate program risk, but delving into the data at the subcategory level uncovered a different picture. Arraying the lower-level DCMA component ratings against the DAES summary ratings showed that although the DAES ratings never changed from moderate risk, the DCMA component ratings showed numerous instances when risk ratings for the IMU were rated as high. Yet the fact that a component essential to the success of the program was seen as high risk because of cracks in components revealed during testing over several rating periods was not brought to the attention of senior decisionmakers. The GPS receiver also experienced problems, with communications and software in this instance, which caused several flight failures. Better use of available data could have signaled potential problems to senior program personnel.