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Digging Out the Root Cause: *Nunn-McCurdy Breaches in Major Defense Acquisition Programs*

Irv Blickstein, Charles Nemfakos, and Jerry M. Sollinger

Continuing concern over defense acquisition has led Congress to direct the establishment of an office in the Department of Defense to oversee the conduct of root cause analyses on programs that have incurred Nunn-McCurdy breaches. Analyses of six programs that have incurred such breaches reveal that many of the causes of the breaches are common to several programs. However, each program is different, and those differences suggest that policymakers should be wary of applying policies that assume all program cost increases stem from common causes.

Image designed by Diane Fleischer »

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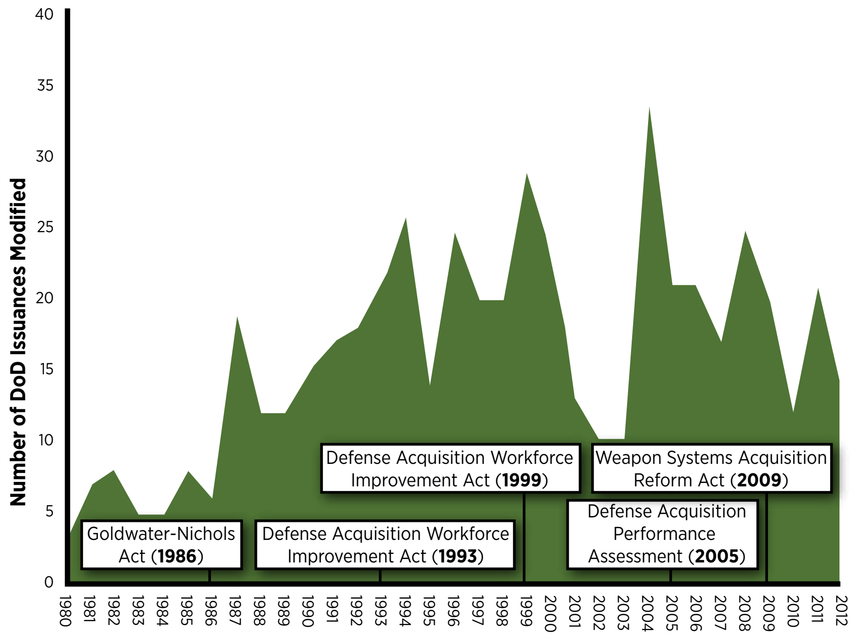
Congress has long been concerned about cost overruns in Major Defense Acquisition Programs (MDAPs). Beginning in the 1970s when it expropriated the Selected Acquisition Report (SAR) as a gauge of program performance, Congress has continued to create mechanisms to gain insights into program execution.[1] However, SARs did not become a legal reporting requirement until 1975, with Public Law (Pub. L.) 94-105 (Leach, 2003). In 1981, Senator Samuel Nunn and Congressman David McCurdy introduced the Nunn-McCurdy Amendment to the Department of Defense Authorization Act, 1982 (Pub. L. 97-86, 1981). The purpose of the amendment was to establish congressional oversight of defense weapon systems acquisition programs whose costs rise above certain limits. The Nunn-McCurdy Amendment defines two types of unit cost. The first is total program acquisition unit cost (PAUC), which is the sum of development cost, procurement cost, and system-specific military construction for the acquisition program, divided by the number of fully configured end-items to be produced for the acquisition program. The second is average procurement unit cost (APUC), which is the procurement funding divided by the number of units procured. Cost growth of a weapon system was measured by how much the unit costs in 1982 exceeded the same respective unit costs reported in the weapon system's SAR dated March 31, 1981. Hence, the amendment applied only to those major weapon systems reported in SARs dated March 31, 1981. The original amendment required the Secretary of Defense to notify Congress when a major weapon system's unit cost growth exceeded 15 percent. If unit cost growth exceeded 25 percent, the program was assumed terminated unless the Secretary of Defense submitted written certifications to Congress within 60 days of determining that a breach had occurred. The provisions were made permanent in the Department of Defense Authorization Act, 1983, and these breaches are commonly referred to as Nunn-McCurdy breaches.

Over time, the Department of Defense (DoD) leadership promulgated many external as well as internal initiatives to reform the acquisition system. Figure 1 captures the DoD Issuances as well as a few of the major initiatives pushed by Congress and by the DoD leadership, where the acquisition system has been the prime focus. Clearly, over time these efforts for reform have increased.

The National Defense Authorization Act for Fiscal Year 2006 changed the Nunn-McCurdy reporting requirements to include the original baseline as a benchmark against which to measure cost growth.

FIGURE 1. DoD ISSUANCES AND REFORM OVER TIME



The Weapon Systems Acquisition Reform Act (WSARA) of 2009 is the latest effort, and it incorporates definitions for two categories of weapon system breaches: significant and critical (Pub. L. 111-23, 2009). A breach is determined by comparing original and current PAUC and APUCs, and a breach can occur if the unit costs exceed either the current or the original baseline by a specific percent. Thresholds appear in Table 1.

The National Defense Authorization Act for Fiscal Year 2006 changed the Nunn-McCurdy reporting requirements to include the original baseline as a benchmark against which to measure cost growth.

Congressional interest in, and efforts to contain spending on, defense acquisition have continued (Government Accountability Office, 2011). The Weapon Systems Acquisition Reform Act (WSARA) of 2009 established a number of requirements that affected the operation of the Defense Acquisition System and the duties of the key officials who

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TABLE 1. BREACH THRESHOLDS

Level	Unit Cost	Baseline	Threshold
Significant	PAUC	Current	>=15%
	APUC	Current	>=15%
	PAUC	Original	>=30%
	APUC	Original	>=30%
Critical	PAUC	Current	>=25%
	APUC	Current	>=25%
	PAUC	Original	>=50%
	APUC	Original	>=50%

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 Analyses (PARCA) for MDAP (Pub. L. 111-23, 2009).

Pub. L. 111-23 assigned the resultant PARCA organization five primary responsibilities:

1. Carrying out performance assessments of MDAPs;

2. Performing root cause analysis (RCA) of MDAPs whose cost growth exceeds the threshold as detailed in the Nunn-McCurdy provision;

3. Issuing policies, procedures, and guidance governing the conduct of performance assessments and RCAs;

4. Evaluating the utility of performance metrics used to measure the cost, schedule, and performance of MDAPs; and

5. Advising acquisition officials on performance issues that may arise regarding an MDAP.

The PARCA office has a relatively limited staff, and reporting deadlines for breaches are short—less than 2 months. Therefore, the director has asked outside organizations, primarily federally funded research and development centers, to assist in conducting the RCAs directed by the law. RAND has supported the PARCA office by analyzing six programs: the Zumwalt-Class Destroyer (DDG-1000), the Joint Strike Fighter F-35, Longbow Apache Helicopter, Wideband Global Satellite, Excalibur artillery round, and the Navy Enterprise Resource Program. Further, RAND has recently completed the analysis of the Joint Tactical Radio System Ground Mounted radio, the P-8A Poseidon aircraft, and modifications to the Global Hawk Unmanned Aerial Vehicle.[2]

Purpose

This article has four purposes. First, it briefly describes the methodology RAND developed to carry out RCAs. The approach to RCAs has matured over time and may prove useful to other organizations that either must do an RCA or wish to understand what the process involves. Second, it presents an example of such analyses—the Wideband Global Satellite, a program with both significant and critical breaches. Third, the article provides insight into the causes of breaches across several programs. Fourth, it offers lessons learned about breaches and how to avoid them.

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Methodology for Root Cause Analysis

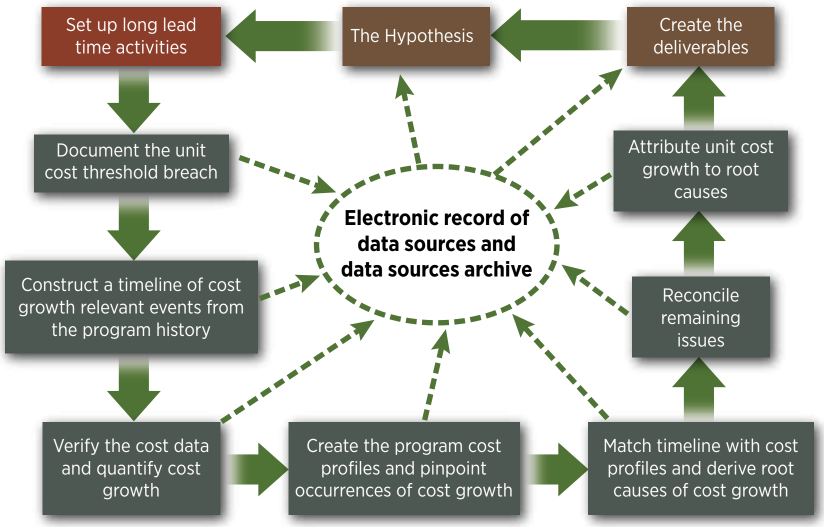
Congressional deadlines for an RCA are tough to meet for two reasons. First, the time available to do them is short. Depending on the circumstances, the RCA must be done in either 45 or 60 days.[3] Second, each RCA is unique because each program is unique. Thus, no "cookbook" spells out all the components and identifies key documents and their locations. RAND has developed a generic methodology, depicted in Figure 2.

The generic process is designed to use the short time available as efficiently as possible. The process is general enough that it can apply to the RCA of any system yet still accommodate the unique attributes of each system. It begins with a hypothesis about what caused the program to breach the threshold. That hypothesis guides many of the subsequent activities, including setting up interviews with key players both in industry and government, which can take some time to arrange. Work has to proceed in parallel so that the required products can be delivered to the PARCA office in a timely manner. In the RCAs performed to date, the PARCA office has requested the following deliverables:

- a completed root cause matrix in the format supplied by the PARCA office;
- a summary narrative;
- a set of briefing charts based on the narrative; and
- a full RCA report.

All deliverables except the full RCA report should be supplied by PARCA office deadlines to ensure that these materials can be used to support the recertification decision.

FIGURE 2. GENERIC RCA METHODOLOGY



Root Cause Analysis of Wideband Global Satellite (WGS) Program

The WGS program was funded in 2001 to acquire an unprotected wideband satellite communications (SATCOM) capability by using a commercial off-the-shelf satellite bus and Ka-band technology, thereby meeting DoD's demand for military SATCOM. WGS provides both X-band communications compatible with the older Defense Satellite Communications System (DSCS) platforms and Ka-band broadcast capability like the Global Broadcast System (GBS). Throughput for each satellite is estimated at over two gigabits per second (U.S. Air Force [USAF], 2007).

The program consists of two phases or "blocks," as shown in the first row of Table 2. Block I of WGS comprises three satellites, the last of which went into orbit in December 2009. WGS Block II consists of three additional satellites—two contracted for the United States to replace aging DSCS and GBS satellites, and a third wholly purchased by Australia in exchange for a percentage of global WGS bandwidth. Block II satellites are essentially the same as Block I, with a high-bandwidth bypass feature for aerial intelligence, surveillance, and reconnaissance platforms (Block I, 2010, p. 16.) With the delays and eventual cancellation of the Transformational Satellite Communications System, DoD

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TABLE 2. WGS AVERAGE PROCUREMENT UNIT COST (EXCLUSIVE OF LAUNCH COSTS)

	Original APB	Current APB/ Original APB	Estimate/ Current APB	Estimate/ Original APB
Block	I	I & II	I, II, IIf	I, II, IIf
Satellites	1–3	1–5	1–8[a]	1–8[a]
Contract type	FFP	FPIF	FPIF	FPIF
APUC	$268m	$294m	$374m	$374m
Unit cost[b]	$239m	$377m[c]	$574m	$574m
% Δ APUC	-	110%	127%	140%
% Δ Unit Cost	-	158%	152%	240%

Note. APB = Acquisition Program Baseline; FFP = Firm Fixed Price; FPIF = Fixed Price Incentive Firm (Target Price).

[a] WGS 6 was purchased for Australia and does not show up in U.S budget accounts.

[b] That is, cost to the government.

[c] Cost claims currently made by Boeing would suggest that the true cost of the first three satellites was roughly $377m.

decided to procure the seventh and eighth WGS satellites—Block IIf—with a planned total buy of 12 WGS satellites to meet future broadband communication requirements (Edwards, 2010).

The Nunn-McCurdy Breach

The unit cost to the government of WGS Block II was roughly 50 percent more expensive than Block I ($377 million compared with $239 million), and Block IIf is again roughly 50 percent more expensive than Block II ($574 million compared with $377 million), as shown in the bottom row (Table 2).

Table 2 illustrates the breach. The 27 percent increase between the current estimate and the current Acquisition Program Baseline (APB) (third column) exceeds the 25 percent threshold for a “critical” breach. (The 40 percent increase [fourth column] between the current estimate and the original APB represents a “significant” but not “critical” Nunn-McCurdy breach.)

The averages, in turn, permit calculation of a unit cost for Blocks I, II, and Block IIf, but not in a straightforward manner.[4] In real (Base Year [BY] 2001 $) terms, the PAUC of the WGS satellite rose 58 percent between Block I and II (from $239 million to $377 million). Unit costs between Block II and Block IIf are projected to rise 52 percent (from $377

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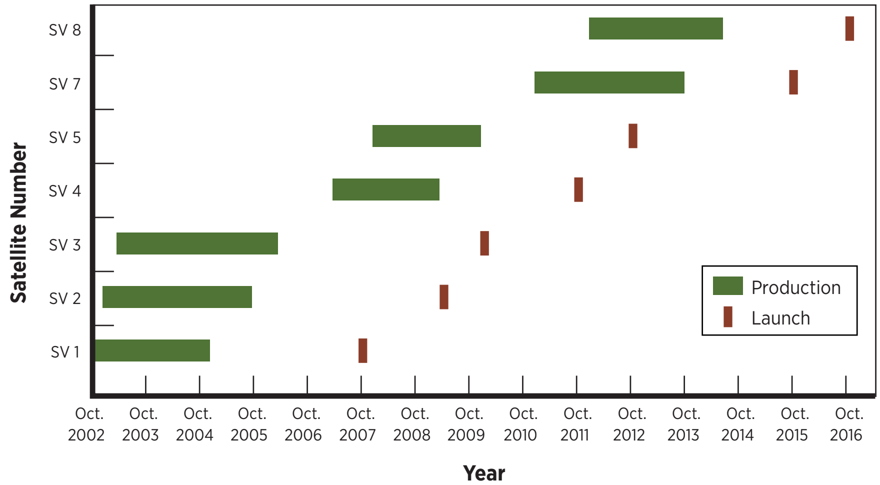
TABLE 3. WGS ORDER AND LAUNCH YEARS

	Satellite	Budget Year	Launch Year	Difference in Years
Block I	1	2002	2007	5
	2	2002	2009	7
	3	2003	2009	6
Block II	4	2007	2011*	5*
	5	2008	2012*	4*
	6 (Aus.)	2009	2013	4*
Block IIf	7	2011	2016	5
	8	2012	2017	5

Note. Aus. = Australia
* These are the launch dates taken from the President's 2012 budget.

FIGURE 3. WGS PRODUCTION/LAUNCH PERIODS



Note. Launches do not include MexSAT-1 and MexSAT-2. Launch dates will follow MexSAT-3.

million to $574 million). Table 3 indicates when each WGS satellite was ordered, when delivered, and the difference in years; Figure 3 indicates the interval during which the USAF-purchased WGS satellites were built and launched. Table 3 indicates a large gap between WGS Block I and WGS Block II, and a smaller gap between WGS Block II and WGS Block IIf. However, the time between program approval and launch for WGS Block I was 5 to 7 years, and the expected cycle time for WGS Block II is

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shorter—4 to 5 years. If current launch dates for Block IIf prove accurate, then the gap between Block I and Block II will be somewhat smaller than the gap between Block II and Block IIf.

Sources of the Nunn-McCurdy Breach

The WGS cost breach has two components: the increase in unit costs between Block I and Block II satellites, and the increase in unit costs between Block II and Block IIf satellites. The first difference was ascribed to "what proved to be an artificially low cost for the original three vehicles under a firm fixed-price contract" (Secretary of the Air Force M. B. Donley, personal communication, March 8, 2010). We focus on the latter cost increase, largely because it is the current one and, thus far, more relevant to decisions to be made on the WGS program.

Table 4 shows both blocks in terms of target and ceiling costs. The latter includes margin sufficient to account for the possibility of cost overruns on the FPIF work (combining advanced procurement, base procurement, and launch support costs).

How do $555 million and $410 million in current dollars (Table 4) compare with the $574 million and $377 million (in BY 2001 $)? Table 5 illustrates the difference.

TABLE 4. PROGRAM OFFICE UNIT COST BREAKDOWN (CURRENT $)

	BY	Target	Ceiling
Block II	2007	$355m	$410m
Block IIf	2011	X	$555m

Note. $ shown are program estimates.

Several features merit note. First, storage and factory restart costs were very small in going from Block I to Block II, but substantial in going from Block II to Block IIf even though the gap before restarting production was 4 years for Block II and only 2½ years for Block IIf. We could not explain this difference. Second, in both cases, Other Government Costs (estimated based on data from the program office and Secretary of the Air Force) are fairly large, but roughly the same in both cases. These costs include contracting office and engineering costs; it was *estimated* by subtracting known cost components from total cost components and checked for overall reasonableness and consistency.

TABLE 5. RELATING BASE YEAR AND CURRENT YEAR COSTS ($ IN MILLIONS)

	Block II	Block IIf
Unit cost (BY01 $)	377	574
Inflation factor to current costs	1.14 (BY07)	1.207 (BY11)
Unit cost current year dollars	430	693
Less storage and factory restart	4	73
Subtotal	426	620
Less other government costs	71	65
Subtotal (from Table 4)	355	555

Third, and most importantly, Boeing's price figure for the Block II satellite, as a basis for comparison, is $355 million each rather than the $410 million ceiling price. Why? The $355 million represented the contracted, hence targeted, price of the satellites; if Boeing costs were higher than $355 million, then, under the terms of the contract, the federal government would reimburse Boeing only for 80 percent of those additional costs. The $410 million was the ceiling price; Boeing would have to absorb all costs in excess of that amount. Building the Current APB APUC (for Blocks I and II) out of Boeing's price, but building the Expected APB APUC (for Blocks I, II, and IIf) out of the ceiling price essentially compares apples and oranges. In effect, the WGS program office built a 15 percent factor—essentially an accounting artifact—into the price. We cannot explain the programmers' motivation for doing so, particularly because it led to a critical Nunn-McCurdy breach that otherwise could have been avoided. Whether this difference represents their lack of confidence in the estimate can only be a matter of speculation. Were this 15 percent removed, then the unit cost of Block IIf would have been $516 million (in current $) rather than $574 million, yielding an APUC of $357 million or an increase of 22 rather than 27 percent, representing a "significant" rather than "critical" breach. Nonetheless, $555 million is still a substantial increase over $355 million—and needs to be explained. Table 6 lists the various factors.

We start with Boeing's price of $355 million. Next we add the current cost overrun of 3 percent ($11 million). (Although the final cost overrun may be higher or lower, we presume that cost overruns experienced to date establish a new baseline for what it really costs to build a WGS, hence $366 million.) The next adjustment, line 4, factors in 4 years'

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TABLE 6. COST INCREASE BETWEEN BLOCK II AND IIF (CURRENT YEAR $)

Increase Component	Block II
1. Boeing price (BY 2007 $)	$355m
2. 3% cost overrun	$11m
3. Actual unit costs (BY 2007 $)	$366m
4. Four years' inflation at 3.5% per year	1.147*
5. Expected unit cost circa 2011	$420m
6. Extra tests	$2m
7. Higher component prices for 3 items	$35m
8. Higher component prices overall	$25m
9. Subtotal	$482m
10. Risk premium of 15%	$555m

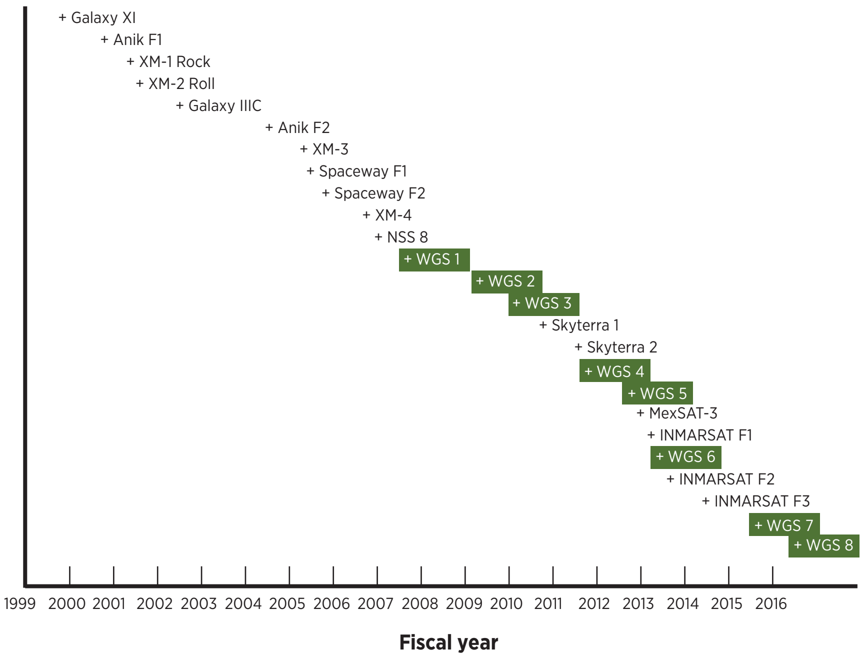
* (1.035 x 1.035 x 1.305 x 1.035 = 1.147 x $366m = $420m)

worth of inflation at 3.5 percent per year (as calculated by the program office based on historic experience in satellite component and manufacturing costs),[5] hence the $420 million in line 5. Next comes $2 million for additional tests not required for Block II, $35 million (as calculated by Boeing) to pay for three critical components that might otherwise go out of production,[6] and $25 million (also as calculated by Boeing) for cost increases in other components at risk in the supply chain, hence the subtotal of $482 million in line 9. The last adjustment arises from the accounting artifact noted previously—the difference between contract costs used to calculate Block II prices and the ceiling cost used to calculate Block IIf prices. This brings us to the $555 million that the program office uses to calculate unit costs for Block IIf.

Explaining the Cost Differences

The $60 million in component cost inflation (over and above the normal 3.5 percent a year) shown in rows 7 and 8 of Table 6 requires further explanation. Reflecting a general shift in market requirements, Boeing shifted its commercial satellite offerings from its HS702HP (high-power) bus to its HS702MP (medium-power) bus. This shift has left WGS supporting the production of parts that no longer have much commercial demand, thereby raising the cost of these components. That noted, Boeing also reports that the cost ratio between bus and payload is expected to remain constant, and the cost ratio between component costs and Boeing's costs is also expected to remain constant. Both imply that its internal costs have also risen more or less proportionately with component costs. This may be reflected in the charges associated with the cold factory restart noted earlier. Figure 4 indicates a sharp decline in commercial satellite production at about the same time that WGS production started. In the 8 years before 2008, Boeing launched 11 commercial satellites; from 2008 to 2016, it plans to launch six. Although the pace of satellite construction has recovered, it has not returned to earlier levels that characterized the first few years of this century.

FIGURE 4. LAUNCH DATES FOR BOEING-PRODUCED SATELLITES



Component cost inflation also reflects a broader phenomenon—the growing divergence between WGS and its civilian counterpart. Commercial products change constantly; military products change infrequently (but in relatively large chunks) and, in the case of Military Specification products, may not change at all precisely because product qualification is complex. In effect, the WGS, born as a modification to a commercial business line, has evolved to a program that is primarily military. As noted, the WGS satellite bus has diverged from its civilian counterpart. The payload of the WGS satellite consists of Ka-band transponders, and X-band transponders and channelizers to switch between the two. X-band is primarily military to begin with. The commercial market had flirted with Ka-band 10 years ago, but the trend toward terrestrial (fiber optics and cell phones) rather than satellite-based communications has dampened industry's interest in exploring different spectra whose primary virtue is that they are largely unclaimed. Furthermore, the global business of U.S. satellite manufacturers has been hampered by increasingly stringent application of International Traffic in Arms Regulations starting 10 years ago. Components that once could be supported from both WGS and commercial sales increasingly rely on the WGS market, and suppliers must be paid a premium to remain in the market. Similarly, former WGS workers who could count on transferring their skills into very similar commercial work when gaps appear in WGS, face a harder transition. As one observer (Mecham, 2009) notes:

> In its 10-year history, the Boeing division's main platform, the 702, has commonly served big commercial requirements, such as the three current orders for DirecTV and two for Sky Terra. But the platform also has been used for many of the company's major government programs, most prominently the Wideband Global Satcom (WGS) network of six spacecraft that replaces the Defense Satellite Communications System.... WGS and two other major government programs—the Global Positioning System IIF and GOES N-P series—have provided 90 percent of Boeing's recent work. To redress that imbalance, the company began looking for new commercial market entries four years ago and concluded it could take advantage of the 702's flight software, avionics and power management systems to develop a smaller bus. (p. 66)

The days when commercial sales could buoy the resources put into the WGS program between one buy and the next are gone. The economics of WGS increasingly depend on the pace and scheduling of WGS buys alone.

Root Cause Analysis

The 52 percent increase between Block II and Block IIf unit pricing is primarily due to the first three factors listed in Table 7. Such results are necessarily limited by the 60-day window allowed for investigation under the Nunn-McCurdy legislation that curtailed RAND's ability to question subcontractors and analyze many of the cost claims that had to be accepted as valid over the course of the analysis.

TABLE 7. PRIMARY FACTORS FOR BLOCK II TO BLOCK IIF UNIT COST INCREASE (BY 2001 $)

Factor	$ Amount	Percent
Risk premium accounting artifact	$60m	30%
Storage and restart costs	$57m	29%
Increased component costs	$51m	26%
Other (e.g., SATCOM industry inflation, cost overruns)	$29m	15%

The largest factor—almost one-third of the increase—is an accounting artifact where the Block IIf prices, as calculated by the program office, include a 15 percent risk premium, whereas Block II unit costs do not (because they largely reflect expended rather than projected costs). These results represent an apples-and-oranges comparison. Inasmuch as the Block IIf is practically identical to the Block II units that Boeing is already building, Boeing can be realistically expected to produce the satellites at near the target cost, which is 15 percent below the ceiling cost—although Block II is running 3 percent over target. But the ceiling price is what was reported. Next, Boeing is charging for storage and restart costs for the 2½-year hiatus between Blocks II and IIf. On the surface, the cause appears to be the interruption in production, but the 4-year hiatus (measured, as noted, in terms of when satellites were ordered, not when they launched) between Block I and Block II had a cost of only $3.5 million, or less than 7 percent of the current estimate. One explanation is that significant aspects of WGS production are no longer supported by the commercial market and, therefore, require storage and restart expenses during production breaks. Finally, key components of WGS that are no longer supplied to the commercial market will have greatly increased procurement costs, accounting for another 26 percent of the cost increase. The second and third factors support the argument that the root causes of the breach are changes in the commercial market without corresponding changes in the WGS design and procurement, and obsolescence.

Despite these large cost increases, the WGS program is essentially healthy and relatively well managed. The satellites work; three of them are already on-orbit serving customers. These customers are generally happy, which is part of the reason that the currently planned WGS constellation is larger than the one originally planned (more often, total buys decline over the life of a contract). There is no reason to expect that the cost of subsequent satellites after WGS 8 will increase—quite the contrary. Boeing's bid proposals for WGS 9 through 12 suggest that these variants will run $100 million less than WGS 7 did (once due account is taken of the baseline inflation in the satellite industry). Thus, although the cost increases in what should be a stable program may appear startling (and remain somewhat startling even after explanation), this is no indicator of a program facing technological or production problems that cannot be reasonably solved.

The broader lesson learned for this program is that when DoD procurement piggybacks on a commercial base—notably the commercial base of a particular company—it takes a risk. The base may shrink, leaving it with less capacity to cover total overhead costs. Even if the base does not shrink, it will evolve. If DoD requirements do not evolve in parallel—and there is no inherent reason why they should—the divergence between DoD's requirements and the market's requirements means that either the requirements are compromised (admittedly, this may be acceptable in some circumstances) or, eventually, such programs have to stand or fall on their own merit. They can no longer be free riders, so to speak. This suggests that a certain procurement discipline is called for, or DoD will pay the difference. Start-stop programs cost more than steady-state programs (i.e., when buys are consistent from one year to the next), which, in turn, are somewhat more costly than total-buy programs. Although DoD cannot necessarily commit to even procurements for a variety of reasons (e.g., changing requirements, risk management, congressional politics), everyone concerned should understand that maximizing acquisition flexibility entails costs.

WGS Conclusions

Three primary factors contribute to the Nunn-McCurdy breach: an accounting artifact, increase in the cost of component parts, and storage and restart costs. Each contributes to about one-third of the cost increase between Block II and IIf. An underlying factor of the increase, particularly with respect to the storage and restart costs, is the change that occurs in the commercial product base that affected the WGS costs. The government incurred additional costs because the commercial base of Boeing no longer supported the WGS.

Common Root Causes and Lessons Learned

Table 8 displays the root causes of breaches in the six programs examined. It places the causes of the various program breaches in three categories: planning, changes in the economy, and program management. The check marks indicate either a root cause or a root cause with relatively greater effect in causing the program to breach.

As can be noted, while these six programs reveal certain cost growth characteristics, they also reflect important differences in how and why cost growth occurred. This point is an important one for policymakers to keep in mind because they sometimes attempt to universalize policies as if all program cost increases stem from common causes.

Understanding the principle that quantity change is rarely a governing root cause for cost growth is fundamental to investigating cases where quantity changes accompany unit cost threshold breaches.

Table 8 indicates that quantity increases or decreases figured into all six of the programs listed. However, RAND's experience suggests that while quantity change can affect a program in important ways, such change is *rarely* the root cause of a Nunn-McCurdy breach. For example, the DDG-1000 program went from 10 ships to 3, which naturally raised the unit cost and signaled a breach. But the reason for the quantity change stemmed from a recognition of changes in the operational environment. Similarly, the increase in the Apache quantities was driven by a decision to procure additional helicopters for operational reasons. Understanding the principle that quantity change is rarely a governing root cause for cost growth is fundamental to investigating cases where quantity changes accompany unit cost threshold breaches. The RAND experience to date shows that although programs had associated quantity changes when they incurred Nunn-McCurdy breaches that triggered RCA examinations, in each case the quantity change was grounded in other program-specific factors that resulted in unit cost growth. Uncovering the grounds upon which quantity changes are founded is an important part of the thorough and insightful RCAs demanded by the WSARA.

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TABLE 8. COMPARISON MATRIX OF ROOT CAUSES OF PROGRAM COST GROWTH

Category	Root Cause of Nunn-McCurdy Breach	WGS	Apache	DDG-1000	JSF	Excalibur	Navy ERP
	✓—Root cause ✓✓—Significant root cause						
Planning	Underestimate of baseline cost	✓	✓	✓	✓		✓
	Ambitious scheduling estimates			✓	✓		✓
	Poorly constructed contractual incentives	✓✓			✓		✓
	Immature technologies		✓✓	✓	✓✓		
	Ill-conceived manufacturing process			✓			
	Unrealistic performance expectations			✓		✓	✓
	Delay in awarding contract			✓			✓
	Insufficient Research, Development, Test and Evaluation	✓	✓	✓	✓		
Changes in economy	Increase in component costs	✓✓	✓	✓	✓	✓	
	Increase in labor costs		✓		✓	✓	
	Discontinued/decreased production of components	✓					

Category	Root Cause of Nunn-McCurdy Breach	WGS	Apache	DDG-1000	JSF	Excalibur	Navy ERP
	Decreased demand for similar technology in private sector (economies of scale)	✓					
	Inflation	✓	✓	✓	✓		
	Production delays	✓✓		✓	✓✓		
	Change in procurement quantities						
	Increase	✓	✓✓				✓
	Decrease			✓✓	✓	✓	
Program management	Unanticipated design, manufacturing, and technology integration issues		✓✓	✓	✓✓		✓
	Lack of government oversight or poor performance by contractor personnel			✓	✓		
	Inadequate or unstable program funding	✓	✓	✓	✓	✓	✓
	Accounting artifact	✓					

Note. DDG = Guided Missile Destroyer; ERP = Enterprise Resource Planning; JSF = Joint Strike Fighter.

Based upon our research into the root causes of breaches of the programs analyzed thus far, and an examination of similarities and differences as reflected in Table 8, RAND offers three overarching recommendations:

1. In the development of early program planning, understand thoroughly the implication of the testing regimes and the numbers of test articles required to execute those regimes. Planning for the testing regime and use of simulation cannot be overstated. As noted in previous RAND research, the F-35 exemplified that problem (Blickstein et al., 2011, pp. 1, 15–16).

2. Clearly stipulate costing methodologies that rely on commercial production or even commercial production practices. The danger is both that necessary cost controls will not be implemented and that important cost analysis alternatives will not be recognized and used. Based on research conducted by RAND with the PARCA at the WGS program office, there does not appear to be a good understanding that fabricating a vehicle to be used by the military can cost significantly more than a commercial vehicle with an international "list price."

3. Where a program depends upon planned product improvements over time, ensure a clear understanding of relationships among several factors, primarily time in inventory, ongoing research and development, and periodic platform upgrades or blocks through the entire out-year period. Failure to understand this can cause program managers to lose sight of program cost growth, as was the case with the Apache Longbow.

Acknowledgment

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Author Biographies

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References

Blickstein, I., Boito, M., Drezner, J. A., Dryden, J., Horn, K., Kallimani, J. G., … Wong, C. (2011). *Root cause analyses of Nunn-McCurdy breaches: Zumwalt Class Destroyer, Joint Strike Fighter, Longbow Apache, and Wideband Global Satellite* (Vol. 1). Santa Monica, CA: RAND National Defense Research Institute.

Block I of WGS Constellation completed. (2010, March 8). *Aviation Week & Space Technology, 172*(10), 16.

Department of Defense Authorization Act, 1982, Pub. L. No. 97-86 (1981).

Department of Defense Authorization Act, 1983, Pub. L. No. 97-252 (1982).

Edwards, J. S. (2010, January 25). Military space becomes increasingly important as capabilities mature. *Aviation Week & Space Technology, 174*(4), 122.

Leach, B. (2003, May). *Acquisition reporting overview & unit cost reporting/Nunn-McCurdy breaches.* Office of the Under Secretary of Defense (Acquisition, Technology and Logistics) briefing to AT&L personnel (pp. 9–11). Retrieved from http://www.google.com/search?q=Leach%2C+B.+%282002%2C+June%29.+Acquisition+reporting+overview&rls=com.microsoft:en-us:IE-Address&ie=UTF-8&oe=UTF-8&sourceid=ie7&rlz=1I7GGHP_enUS476

Mecham, M. (2009, December 7). Hosted payloads growth eyed by U.S. satellite makers. *Aviation Week & Space Technology, 171*(21), 66.

U.S. Air Force. (2007). *The Air Force handbook.* Retrieved from http://www.fas.org/irp/agency/usaf/handbook.pdf

U.S. General Accounting Office. (1980). *Comptroller General's report to the Congress: 'SARs' – Defense Department reports that should provide more information to the Congress* (Report No. PSAD-80-37). Retrieved from http://archive.gao.gov/f0102/112285.pdf

U.S. Government Accountability Office. (2011). *High-risk series: An update* (Report No. GAO-11-278). Washington, DC: Author.

Weapon Systems Acquisition Reform Act of 2009, 10 U.S.C., Pub. L. 111-23 (2009).

Endnotes

1. The SAR's initial purpose was to act as a vehicle to keep its sponsor, the Assistant Secretary of Defense (Comptroller), apprised of the progress of selected acquisitions and to compare this progress with planned technical, schedule, and cost performance. In February 1969, the Chairman of the Senate Armed Services Committee asked the Secretary of Defense to provide status reports on major weapons systems. The parties agreed in April 1969 that the SAR would be the vehicle to satisfy the committee's needs (U.S. General Accounting Office, 1980).
2. RAND is a nonprofit institution whose mission is to help improve policy and decision making through research and analysis. The name is an acronym for "research and development."
3. The 45-day period between program manager report of a breach and military department secretary notification of a critical unit cost breach to Congress starts the day after the initial report of the breach to the Service Acquisition Executive. The 60-day period within which the Secretary of Defense must submit a program recertification decision to Congress starts on the day after the due date of the first SAR that reports the breach.
4. Note that the original APB was $268 million (fifth row, Table 2) per satellite, but the unit cost is now estimated to be $239 million (fourth row, Table 2). The difference between the two is accounted for by the fact that other government costs ended up $29 million per satellite lower than estimated.
5. Note that this 3.5 percent exceeds the 1.8 percent used as an overall price deflator by the Office of the Secretary of Defense to convert constant into current dollars.
6. The three critical components that might otherwise go out of production were the Xenon Ion Propulsion System (XIPS), certain transponders, and a crypto box.