Defense-Industrial Initiatives Group
Center for Strategic & International Studies

Cost and Time Overruns for Major Defense Acquisition Programs

An Annotated Brief

Authors:
David Berteau
Joachim Hofbauer
Gregory Sanders
Guy Ben-Ari

Researchers:
Jesse Ellman
David Morrow

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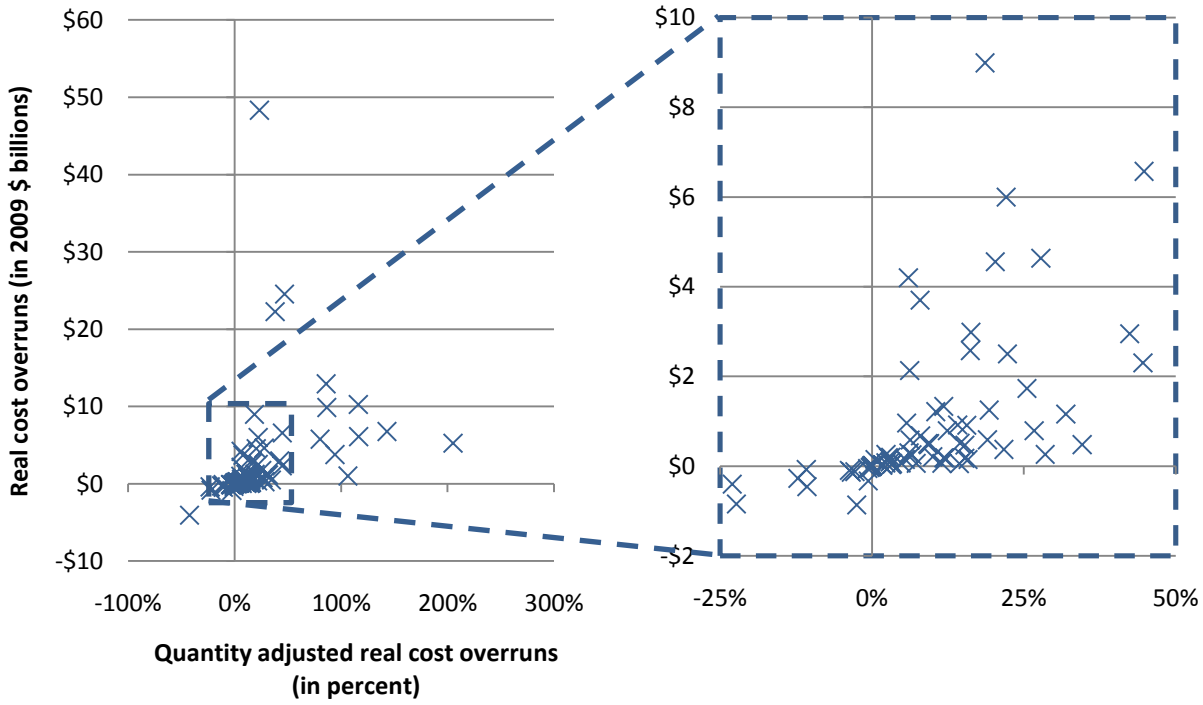
Center for Strategic and International Studies
1800 K Street NW
Washington DC, 20006
202-775-3183
DBerteau@csis.org

Introduction

Cost and time overruns in Major Defense Acquisition Programs (MDAPs) have become a high-profile problem attracting the interest of Congress, government and watchdog groups. According to the GAO, the 96 MDAPs from FY2008 collectively ran $296 billion over budget and were an average of 22 months behind schedule. President Obama's memo on government contracting of 4 March 2009 also highlighted this issue.

This paper presents interim findings of research on the root causes of cost and schedule delays for MDAPs. This research is ongoing and will incorporate the 2010 SAR data. The final findings and policy recommendations will be presented at the May 2011 Naval Post Graduate School annual Acquisition Symposium.

Figure 1: Relative cost overruns versus absolute cost overruns for FY2009 MDAPs



Note: Only FY2009 MDAPs with a baseline estimate beyond Milestone B in the December 2009 SAR were included. As a result programs cancelled since the prior SAR release, specifically FCS and the Small Diameter Bomb, were excluded.

Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

Problem Definition

Past studies on this topic either have not offered rigorous data analysis or were focused on a critical but still narrow aspect of the problem, such as technical maturity. Meanwhile, congressional leadership often focuses on different issues such as contract type and competition. As a result, acquisition reform efforts, most recently the Weapon Systems Acquisition Reform Act of 2009, are hampered by an insufficient analytical basis.

For instance, in its annual assessment of selected weapon systems, the Government Accountability Office primarily focuses on knowledge-based factors such as technology maturity and associated program decisions as causes for these problems. Former Under Secretary of Defense for Acquisition Technology & Logistics John Young claimed in a memorandum on March 31, 2009, that many of the allegations of the GAO are based on inadequate analytical methods and that consequently many of the results are misleading.

This disagreement is exemplary of the diverging set of opinions that exists regarding the root causes of MDAP cost overruns and schedule delays. The result amplifies disagreement regarding potential fixes. On the government side Senator McCain identified the usage of cost plus contracts as a major source for cost increases and Secretary Gates pointed towards the contract structures as a key source of cost and schedule overruns in some MDAPs. Defense contractors, on the other hand, regularly cite the altering of requirements in advanced program stages as an important factor for cost increases.

The currently ongoing process of reforming and fixing the defense acquisition system still lacks the foundation of a detailed evaluation of the causality chain of cost overruns and program delays of MDAPs. This lack of understanding of underlying mechanisms makes the design of adequate solutions inherently difficult and renders them potentially ineffective. This study directly aims at developing the urgently needed knowledge base that will better guide efforts to correct the growing trends of cost increases and schedule overruns.

Methodology

This brief analyzes a series of variables – namely realism of baseline program cost estimates, government management and oversight, the role of contractors and lead military services, levels of competition, and contract structures – to determine what factors might contribute to or be correlated with the observed cost overruns in the execution of MDAPs.

This preliminary research draws on three primary data sources:

Selected Acquisition Reports (SARs): The SARs track Major Defense Acquisition Programs, reporting on their schedule, unit counts, total spending, and progress through milestones. The unit of analysis is the programs themselves, making it the ideal source for top level analysis.

Federal Procurement Data System (FPDS): The FPDS is a database of every government contract, with millions of entries each year. Each entry has extensive data on the contractors, contract type, competition, place of performance, and a variety of other topics as mandated by Congress. Cross-referencing individual contracts with MDAPs is possible using the system equipment codes (which match up with those of MDAPs). This source provides the most in-depth data on the government contracting process.

Department of Defense budget documents: In addition to budget data, these documents provide topical information on each MDAP and its subcomponents. They will primarily be used to categorize projects as well as to support and double check spending figures from the other two sources.

The initial analysis phase focuses on MDAPs from the FY2009 MDAP list. Within this sample group the analysis is limited to 85 MDAPs with cost estimates set at Milestone B or beyond. That gate is meant to be a hurdle that requires programs to reach a certain level of technological maturity. As a result Milestone B "is normally the initiation of an acquisition program."[1] This common starting point ensures that only programs in a relatively mature acquisition phase are compared. A side effect of limiting the sample to the FY2009 list is that recently canceled programs such as the Future Combat System are excluded from the sample. Figure 1 provides an overview of the cost overruns of these 85 programs.

Unfortunately, full data are not available on all 85 MDAPs when examining contract type and competition, because not all of the programs have at least 50 percent of the SARs contract value accounted for in 2004-2009 FPDS data. As a result, the 'unclear' category is used to signify this missing data in competition and contract type findings. In addition, FPDS totals for program spending are sometimes higher than the funding status according to the SARs. In those cases, the SAR totals are treated as the more reliable figure.

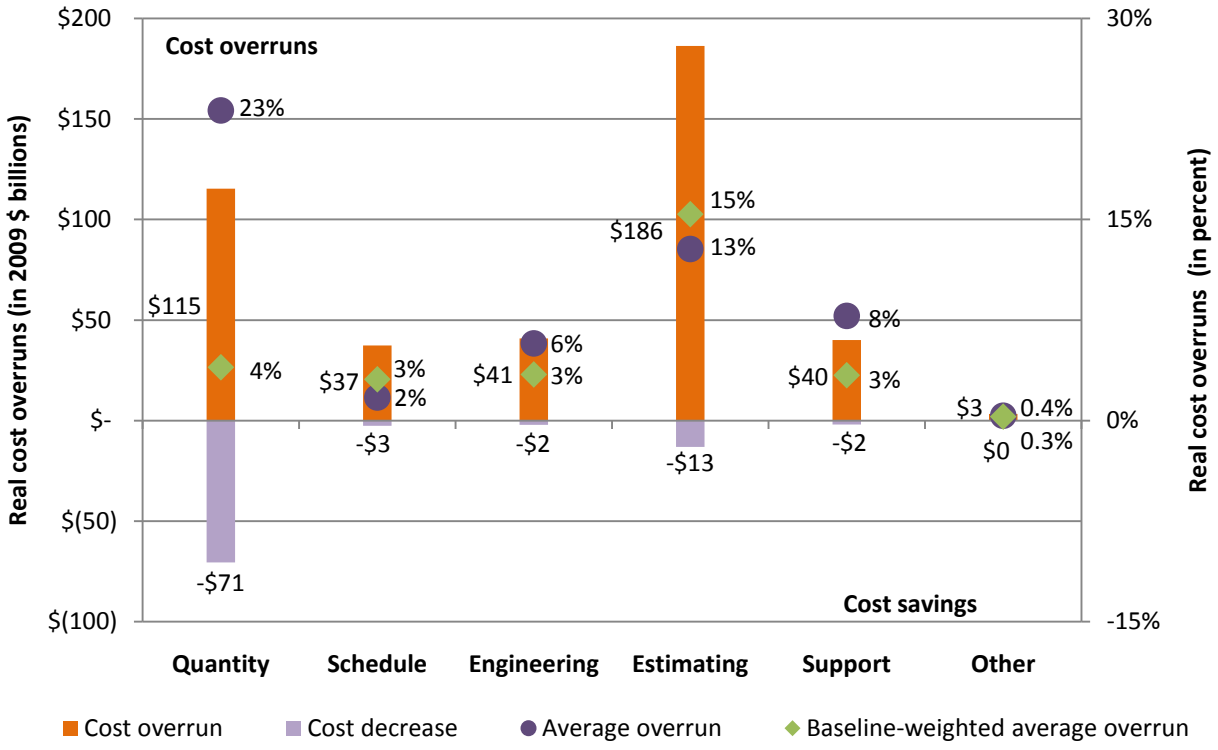
These preliminary snapshots provide an adequate starting point for detecting correlations between a series of potentially relevant factors and cost growth. Subsequent analyses will examine multiple factors at the same time, expand the breadth of the sample group, and also test for correlations with regard to schedule overruns. The charts reflect the basic information; arranged across a variety of data elements, but they do not constitute a basis for judgment or policy changes. Further analysis is needed and is ongoing.

[1] "Acquisition History Project Working Paper #3: The Evolution of DoD Directive 5000.1 Acquisition Management Policy 1971-2003." Defense Acquisition History Project. http://www.history.army.mil/acquisition/research/working3.html, Accessed 5/25/2010.

Analysis

The initial analysis focuses on examining the impact of baseline cost estimates, quantity and schedule changes, as well as engineering problems, the extent of competition, contract structure, lead branch of military service, and identity of prime contractor on the cost performance on MDAPs.

Figure 2: Functional reasons for cost overruns



Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

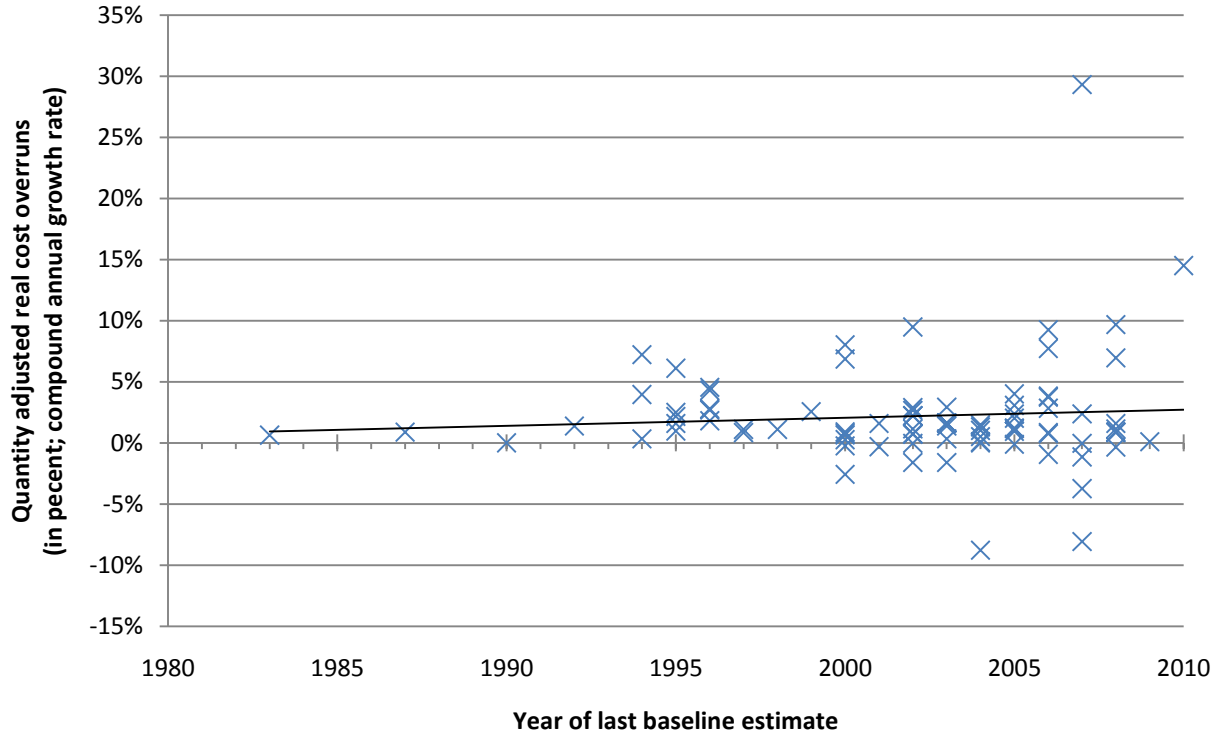
Breaking down cost growth by functional areas as provided in the SARs identifies variances in the estimating process as the primary driver for cost growth, being responsible for $186.3 billion in cost growth for the 85 MDAPs analyzed.

Another noteworthy observation from Figure 2 is the fact that the cost savings achieved through quantity changes offset two-thirds of the cost growth originating from changes in unit numbers. This is not encouraging, as for programs with upfront research and development costs, reducing the number of units lowers the overall program cost but it increases the per-unit cost. In turn, cost increases deriving from increases in the number of units require a higher overall program budget but lower the price per unit.

Nunn-McCurdy breaches, for instance, are based on the growth in the per-unit acquisition cost rather than overall program cost in order to account for this fact. This presentation therefore focuses on quantity-adjusted cost changes. The Selected Acquisition Reports do not list the exact methodology for

quantity adjustments; unfortunately, the adjustment is not equivalent to the sum of cost adjustments that are not attributed to quantity changes. This complicates analysis of the functional reasons for cost growth.

Figure 3: Time-cost correlation



Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

Note: The December 2009 SAR only includes one fiscal quarter of 2010 data. As a result, the number of years of growth is calculated with an end point of 2009. Win-T increment 2 was re-baselined in 2010, but for this chart the compound annual growth rate is calculated as if it were a 2009 program.

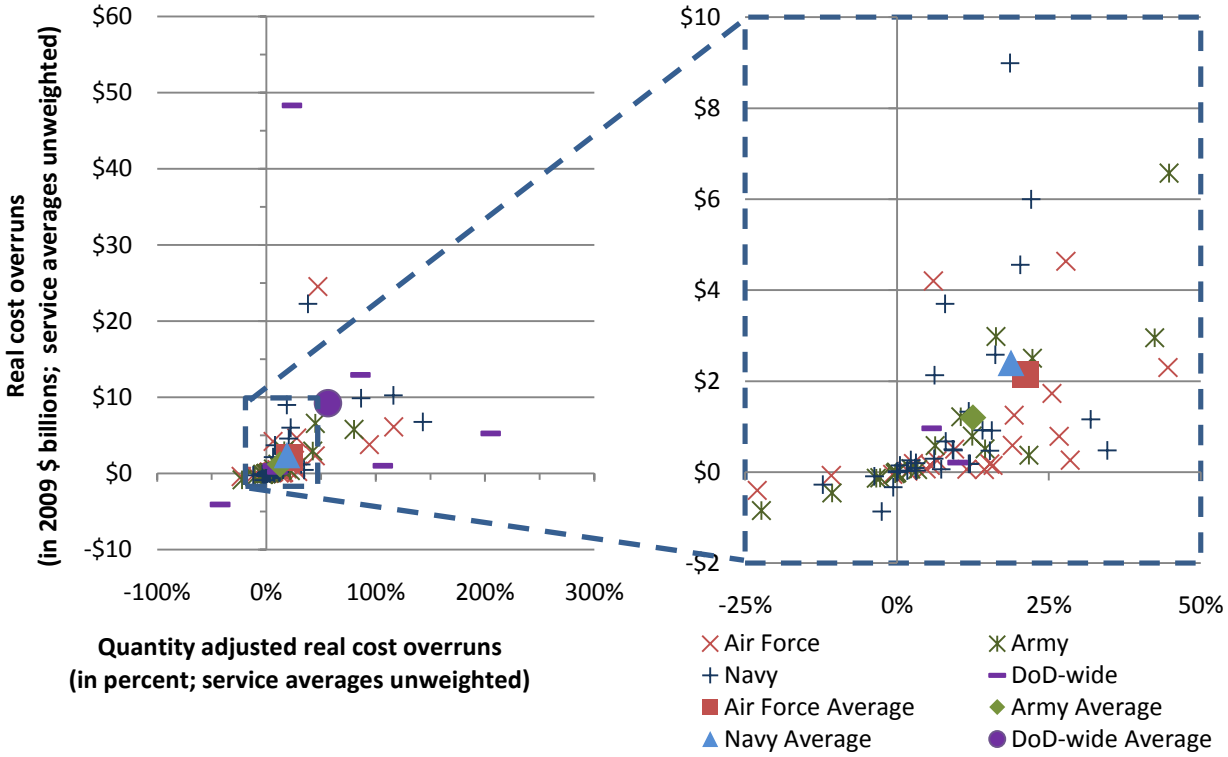
The next explanatory variable examined for its impact on program performance is the time-cost growth correlation. If cost increases accrue over time, then programs with an older baseline estimate would tend to accumulate relatively higher cost increases. The data for the analyzed programs show that older programs indeed experience larger overruns.

However, Figure 3 shows that when measured in compound annual growth rate[2] rather than aggregate relative cost growth, the time-cost growth correlation is almost constant. This does not only provide further evidence for the assertion that cost growth occurs steadily throughout the program lifespan, but it also suggests that younger programs are not performing better than older programs. On the other

[2] The compound annual growth rate describes the average year-to-year cost growth of a program spending since its baseline. Thus if comparing two programs with same percentage of cost growth since their baseline estimate, the program with an earlier baseline year would have a smaller compound annual growth rate.

hand, this sample does not include older programs that were cancelled. Future research with a broadened sample set will be better able to avoid this confounding factor and thus provide more insight into the successful and failures of past reform efforts.

Figure 4: Cost overruns by lead service (I)



Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

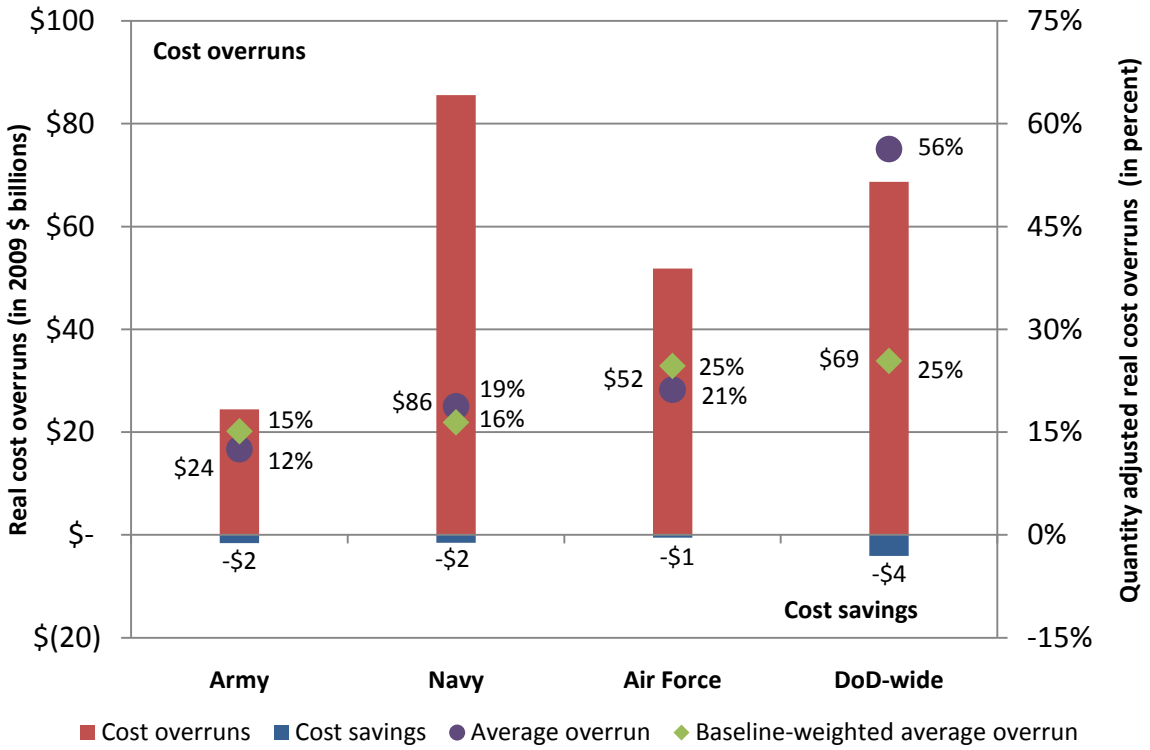
The analysis on the correlation between the lead branch of military service responsible for MDAPs and cost growth patterns reveals that programs led by the Army appear to have fewer, smaller overruns, followed by the Navy and then the Air Force, while DoD-wide programs tend to accrue significant larger cost overruns. The Army's performance is partially a result of the exclusion of the Future Combat System as the program's cancelation meant that it was not included in the 2009 sample. Note that DoD-wide includes both, programs managed by DoD agencies and joint programs such as the Joint Strike Fighter.

The outcome of this data analysis might be skewed based on the relatively small sample group utilized in this preliminary analysis. For instance, it appears that the DoD-wide category might be heavily influenced by the negative cost developments in the Joint Strike Fighter program. As for the other components, further analysis with larger sample groups are required to validate observed trends.

Any conclusions from Figure 4 identifying superior program management of existing programs by service are premature, even if additional data and analysis were to confirm this variation in cost performance

based on lead service. A number of other factors may explain the differences, such as a tendency toward less risk-prone MDAPs. Further research will be needed to analyze the underlying causality and detect the true root causes for these trends.

Figure 5: Cost overruns by lead service (II)

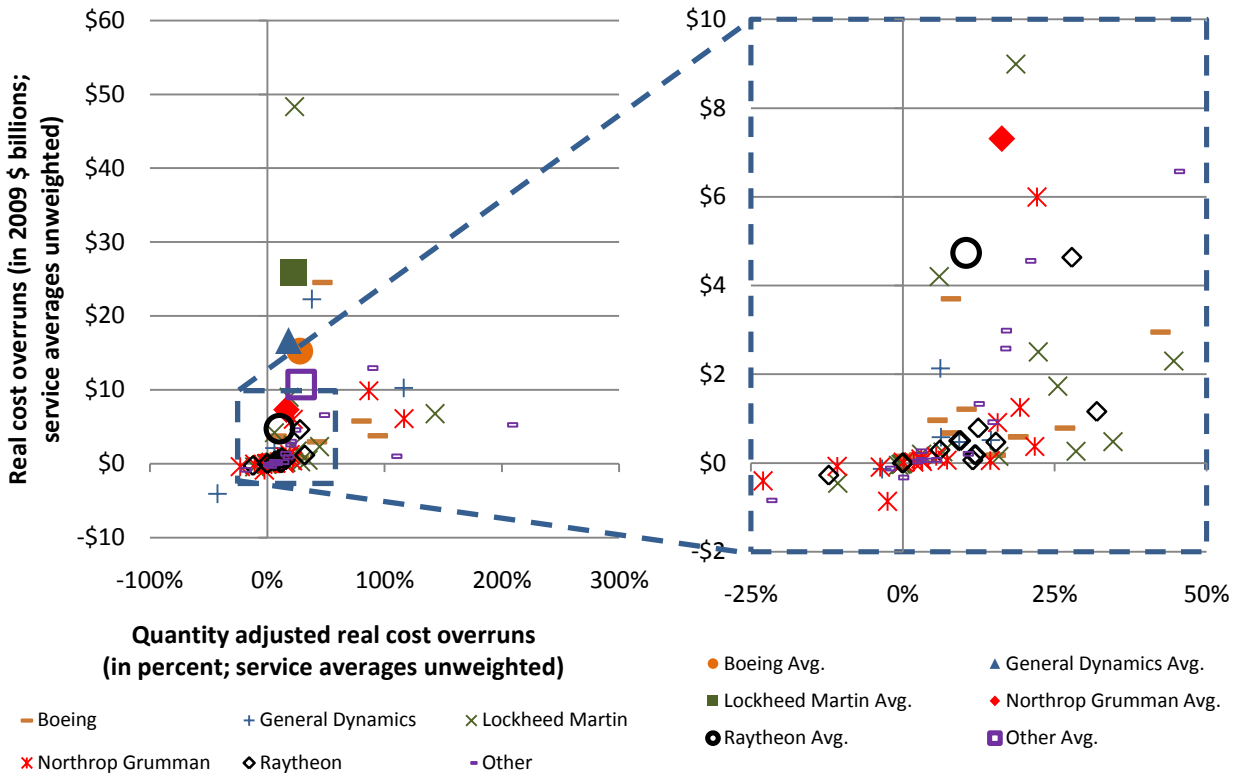


Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

Figure 5 compares the share of cost growth for which each service is responsible with the share of baseline-estimate contract value which each service is managing. It supports the conclusion of the previous chart, with the poorest cost performance in DoD-wide managed MDAPs. The Army shows the lowest total in real cost overruns, although again the exclusion of the FCS makes it difficult to draw larger conclusions. Notably, while the Navy performs relatively well on a percentage basis, it also has the largest share of overruns in absolute terms. This can be attributed to the size and duration of many Navy programs. Expanding the sample to include completed and canceled programs would likely remove that effect.

This comparison provides further support for the assertion that MDAPs managed by the Army and the Navy suffer smaller overruns, while DoD-wide managed MDAPs tend to accrue larger overruns. However, the level of analysis conducted so far does not allow for any firm conclusions on the actual role of any service's program management skills in these trends.

Figure 6: Cost overruns by prime contractor (I)

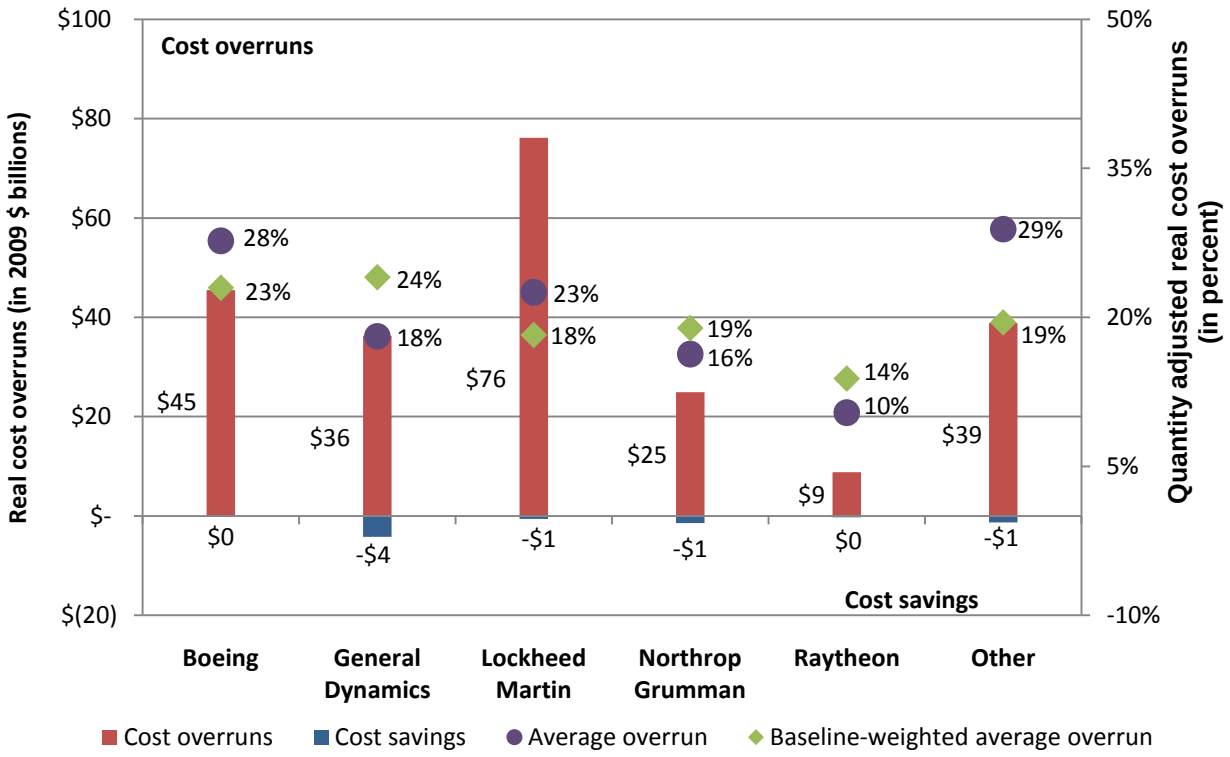


Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

Another predictor for program performance could be the identity of the prime contractor for a given program. One striking trend in Figure 6 that is visible for the "big five" U.S. defense companies is the fact that Raytheon on average appears to be associated with significantly better cost performance outcomes than other defense companies.

The preliminary character of the analysis does not fully validate any findings of superior management or outcomes. In addition, even if confirmed, it would be premature to start praising any company for better program execution, as other factors such as specialization in technologically more mature program areas might be the true drivers behind this trend. As was the case for the breakdown by lead service, further research will be needed to analyze the underlying causality.

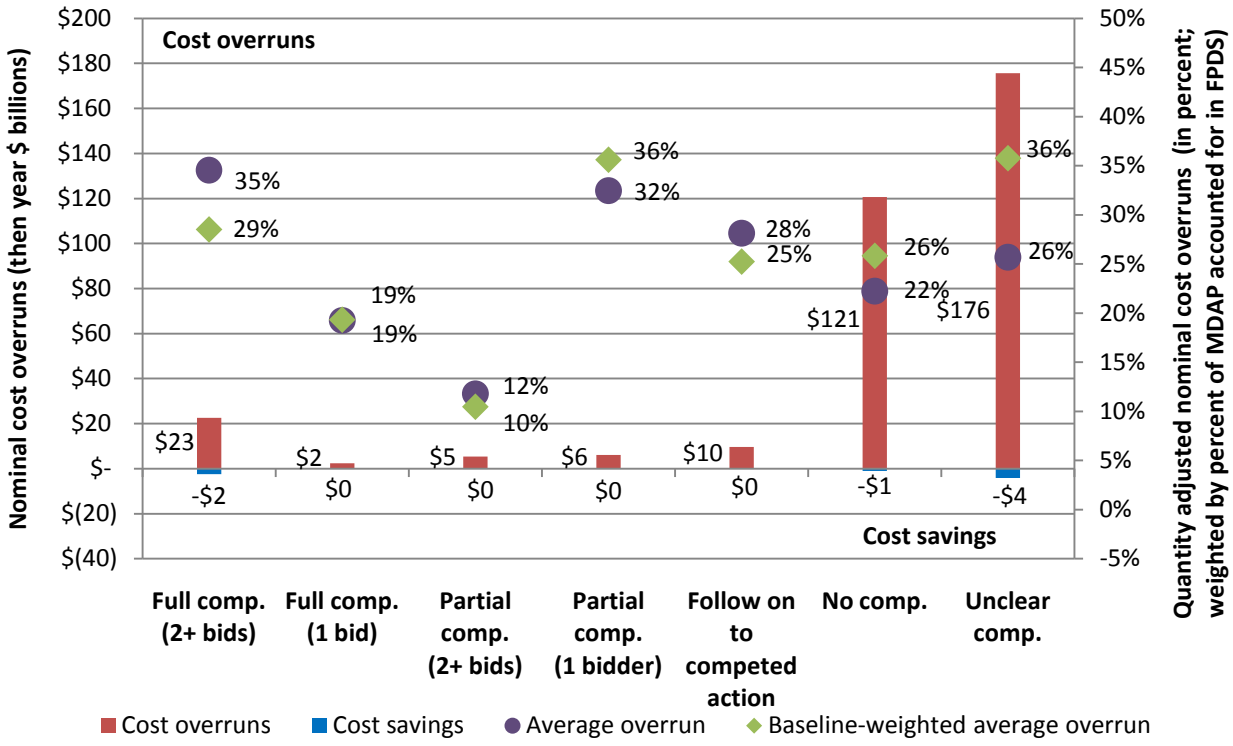
Figure 7: Cost overruns by prime contractor (II)



Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

The comparison between the share of cost growth and the share of contract value for MDAPs, aggregated by prime contractor, correlates with the finding that MDAPs for which Raytheon is the prime contractor appear to exhibit the best cost performance amongst the "big five" defense companies. When it comes to the remainder of the "big five," Figure 7 shows that their average performance varies based on the means used to measure it with different results when the programs are weighted by the baseline estimate than if all of the MDAPs are treated as having an equal weight. Again, this variance give reason to be cautious in extrapolating from these results until the sample size is expanded and more analysis is completed.

Figure 8: Cost overruns by type of competition



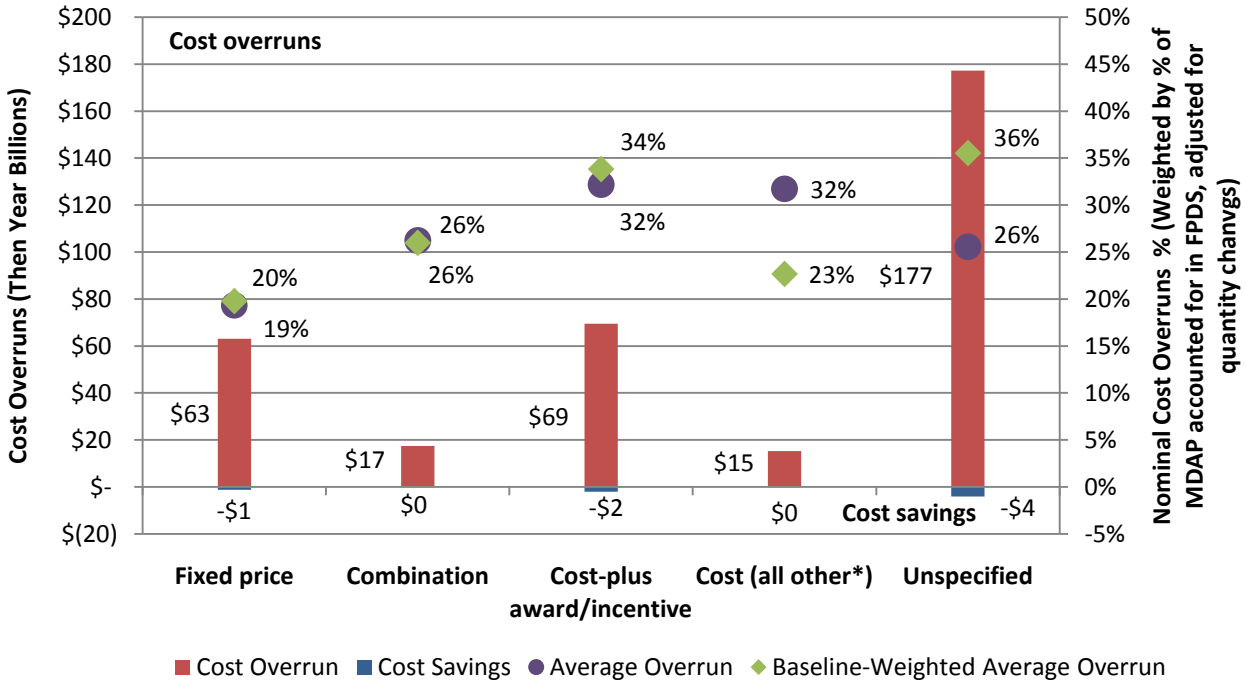
Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

The type of contract award process could potentially also be correlated with cost performance of MDAPs. The findings in Figure 8 are decidedly mixed. In absolute dollar terms, competitive contracts produce less cost growth than contracts awarded with no competition or under unclear circumstances. However, when comparing relative cost overrun rates the results are different. Only partial competition[3] with multiple bidders and open competition with a single bidder display a notably better outcome.

Perhaps surprisingly, full and open competition with multiple bidders performs on par with no or unclear competition. Based on the SAR's data, this can be attributed to having the highest percentage of estimating variance of any of the categories. This result is consistent with the hypothesis that bidders may propose lower costs in order to win price-based competitions. However, further study would be needed to determine whether full and open competitions also suffer from a selection bias or other unexplained cause.

[3] Partial competition refers to forms of competition other than full and open because the number of bidders is legally limited.

Figure 9: Cost overruns by contract type



* Cost (all other) includes time and materials contracts as well as labor hours contracts.
Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

Contract structure provides another possible determining factor for the performance of MDAPs. One key observation from Figure 9 is that fixed price contracts appear to have less cost growth and unspecified contract types appear to have more, when comparing the share of cost growth and the share of contract value for MDAPs.

Acquisition reformers often point toward cost-plus contracts as a factor driving cost overruns. This argument is supported by the high average cost overruns percentages of both categories of cost plus contracts. However, when comparing absolute value or baseline-weighted overrun percentage cost-plus contracts, award fee and incentive as well as conventional, seem not to be responsible for dramatically over-proportional cost growth. In addition, fixed price contracts are more commonly the vehicle of choice for mature technology in full rate production, which are generally considered low risk.

Preliminary findings

The initial analysis yielded a number of preliminary trends and correlations for further analyzing the sources of cost overruns in MDAPs. The strongest correlation with net cost growth is shown in Figure 2: changes in cost estimates are responsible for almost half of the accumulated cost overruns.

Figure 3 shows a similarly important trend: the start year has little impact on the compound annual growth rate of cost overruns. This suggests that the better performance of newer programs may prove illusionary as programs age. If this trend is further validated, it hints toward the concerning conclusion that the acquisition reform efforts prior to 2009 have so far failed to create any improvements for cost performance. However, it must be noted that cost performance as measured in the SARs clearly constitutes a lagging indicator for the impact of any acquisition reform. On the other hand, some of the worst performing older programs of the past have already been cancelled, and if they were included, it would increase the overrun compound annual growth rate for earlier years.

The examination of all of the other examined variables reveals patterns that suggest that each of them, or associated secondary or tertiary factors, could play a role in explaining the occurrence of MDAP cost overruns. While this paper provides some interesting preliminary insights, all of the observed trends need to be further validated through additional analysis and the incorporation of larger sample groups. Afterwards, more rigorous quantitative and qualitative analysis is required to identify the actual root causes for cost overruns, which might be only masked by the examined variables. Ongoing research will lead to better answers about these root causes.

Biographies

David J. Berteau is a Senior Adviser and Director of the CSIS Defense-Industrial Initiatives Group, covering defense management, programs, contracting, and acquisition. His group also assesses national security economics and the industrial base supporting defense. Mr. Berteau is an adjunct professor at Georgetown University, a member of the Defense Acquisition University Board of Visitors, a director of the Procurement Round Table, and a fellow of the National Academy of Public Administration. He also serves on the Secretary of the Army's Commission on Army Acquisition and Program Management in Expeditionary Operations.

Joachim Hofbauer is a research associate with the Defense-Industrial Initiatives Group at CSIS, where he specializes in acquisition policy and defense industrial base issues. His current work focuses on U.S. defense acquisition reform, the European defense market, and root cause analysis for cost and schedule overruns in major defense acquisition programs.

Before joining CSIS, Mr. Hofbauer worked as a defense analyst in Germany and the United Kingdom. Mr. Hofbauer holds an M.A. with honors in security studies from Georgetown University and a B.A. in European studies from the University of Passau.

Gregory Sanders is a research associate with the Defense-Industrial Initiatives Group at CSIS, where he gathers and analyzes data on U.S. defense acquisition and contract spending. Past projects include studying U.S. government professional services contracting, U.S defense export controls, and European defense trends. His specialty is data collection, analysis, and visualization.

Mr. Sanders holds an M.A. in international relations from the University of Denver and a B.A. in government and politics and a B.S. in computer science from the University of Maryland.

Guy Ben-Ari is Deputy Director of the Defense-Industrial Initiatives Group at the Center for Strategic International Studies, where he works on projects related to the U.S. technology and industrial bases supporting defense. His current research efforts involve defense R&D policies, defense economics, and managing complex defense acquisition programs.

Mr. Ben-Ari holds a Bachelor's degree in political science from Tel Aviv University, a Master's degree in international science and technology policy from the George Washington University, and is currently a PhD candidate (ABD) at the George Washington University.