

Defense-Industrial Initiatives Group  
Center for Strategic & International Studies

# Cost and Time Overruns for Major Defense Acquisition Programs

An Annotated Brief

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April 2011

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## **Abstract**

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 98 MDAPs from FY2010 collectively ran \$402 billion over budget and were an average of 22 months behind schedule since their first full estimate. President Obama's memorandum on government contracting of 4 March 2009 also highlighted this issue.

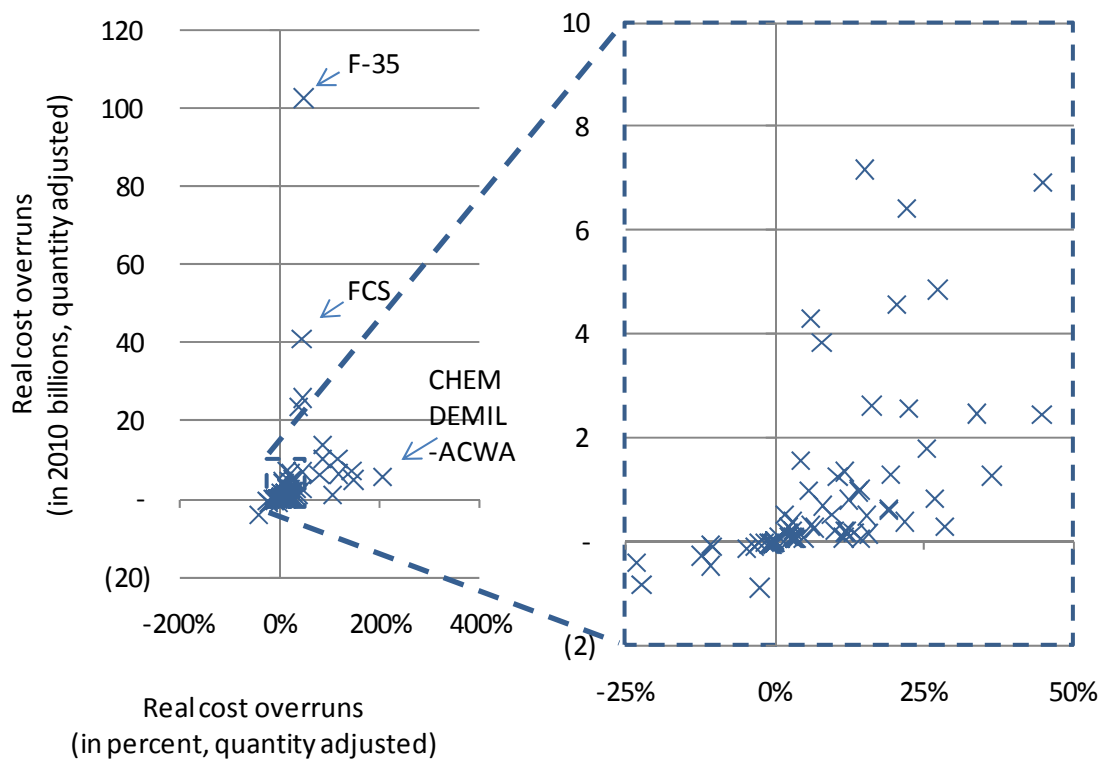
This paper presents findings of research on the root causes of cost and schedule delays for 92 MDAP active in 2010 and 12 cancelled programs. The results do not establish causality but do indicate multiple notable correlations. Inaccurate cost estimates are responsible for the strongest correlation with net cost growth changes and are associated with 40 percent of the accumulated cost overruns. In addition, the start year has little impact on the compound annual growth rate of cost overruns. This suggests that relatively better performance of newer programs may prove illusory as programs age. Finally, fixed price contracts appear to have relatively smaller overruns, although this may tell us more about which programs are likely to receive fixed price contracts rather than what effect fixed price contracts may have on program performance.

## 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 98 MDAPs from FY2010 collectively ran \$402 billion over budget and were an average of 22 months behind schedule since their first full estimate. President Obama’s memo on government contracting of 4 March 2009 also highlighted this issue.

This paper presents findings of research on the root causes of cost and schedule delays for MDAPs, incorporating 2010 SAR data.

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



Note: The sample includes 92 FY2010 MDAPs with a baseline estimate beyond Milestone B in the June 2010 SAR as well as twelve additional cancelled programs, notably including the Future Combat System (FCS).

Source: Selected Acquisition Reports; 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 like 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 predominantly 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 report 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 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 report focuses on MDAPs from the FY2010 MDAP list. Within this sample group the analysis is limited to 104 MDAPs with cost estimates set at Milestone B or beyond, including MDAPs that were cancelled between 1999 and today. 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.”<sup>1</sup> This common starting point ensures that only programs in a relatively mature acquisition phase are compared. Cancelled programs are included to avoid the selection bias that results from excluding several of the worst performing proposals from analysis. Figure 1 provides an overview of the cost overruns of these 104 programs.

Unfortunately, full data are not available on all 104 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 snapshots provide an adequate starting point for detecting correlations between a series of potentially relevant factors and cost growth. The charts reflect the basic information; arranged across a variety of data elements, but they do not constitute a sufficient basis for establishing causality or policy changes, for which further analysis would be needed.

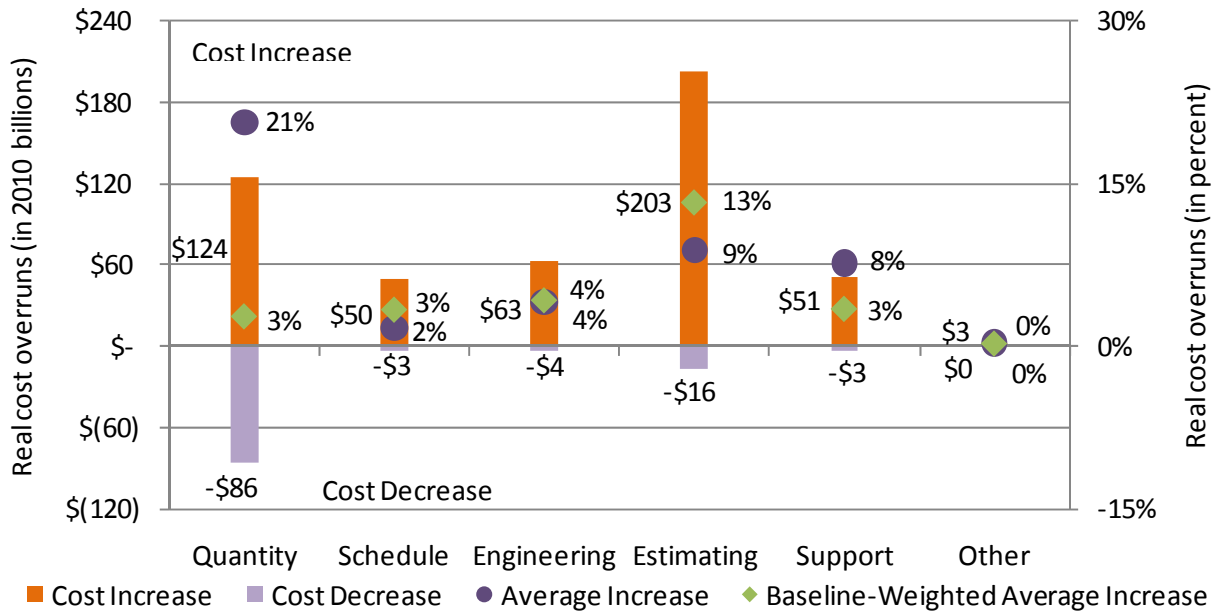
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<sup>1</sup> “Acquisition History Project Working Paper #3: The Evolution of DoD Directive 5000.1 Acquisition Management Policy 1971-2003.” Defense Acquisition History Project.  
<http://www.history.army.mil/acquisition/research/working3.html>, Accessed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

## Analysis

This 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**



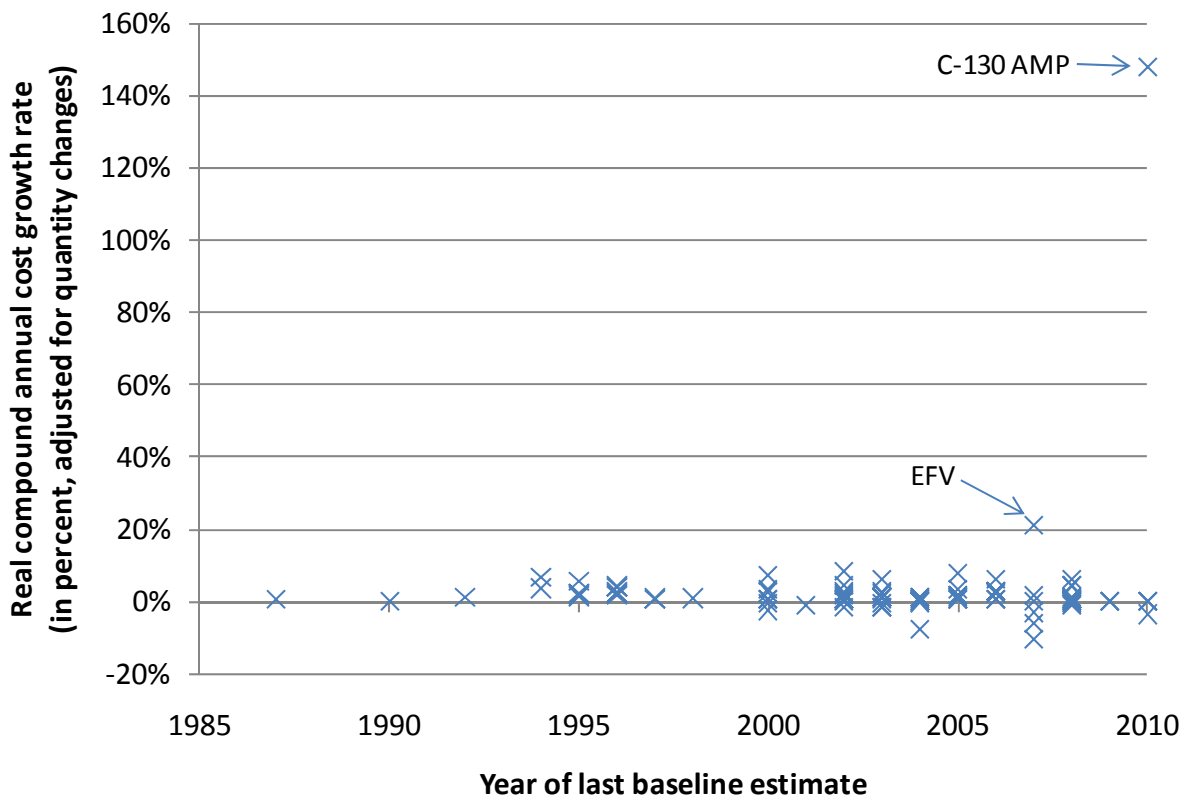
Source: Selected Acquisition Reports; analysis by CSIS Defense-Industrial Initiatives Group

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 \$202.8 billion in cost growth for the 104 MDAPs analyzed.

Another noteworthy observation from Figure 2 is the fact that the cost savings achieved through quantity changes equals approximately 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, effectively curtailing the government's buying power. 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



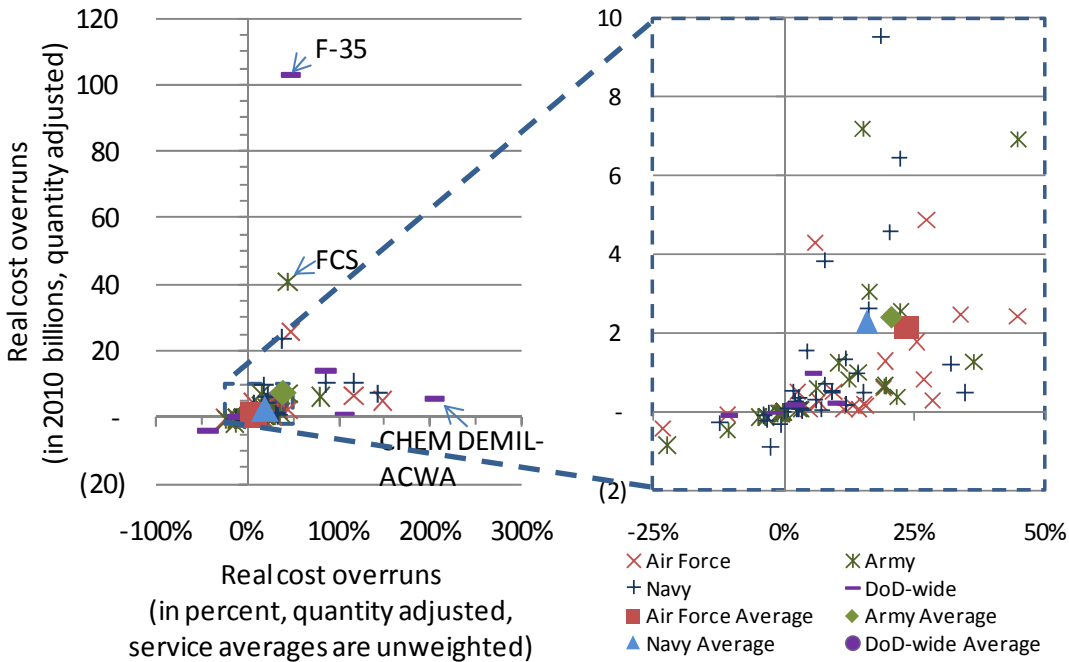
Source: Selected Acquisition Reports; analysis by CSIS Defense-Industrial Initiatives Group

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<sup>2</sup> rather than aggregate relative cost growth, the time-cost growth correlation is almost constant. The C-130 AMP project is distorting this trend, because its estimate was not changed when it was given a new baseline in 2010. Notwithstanding C-130 AMP, this growth correlation not only provides 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.

<sup>2</sup> 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.

**Figure 4: Cost overruns by lead service (I)**



Source: Selected Acquisition Reports; analysis by CSIS Defense-Industrial Initiatives Group

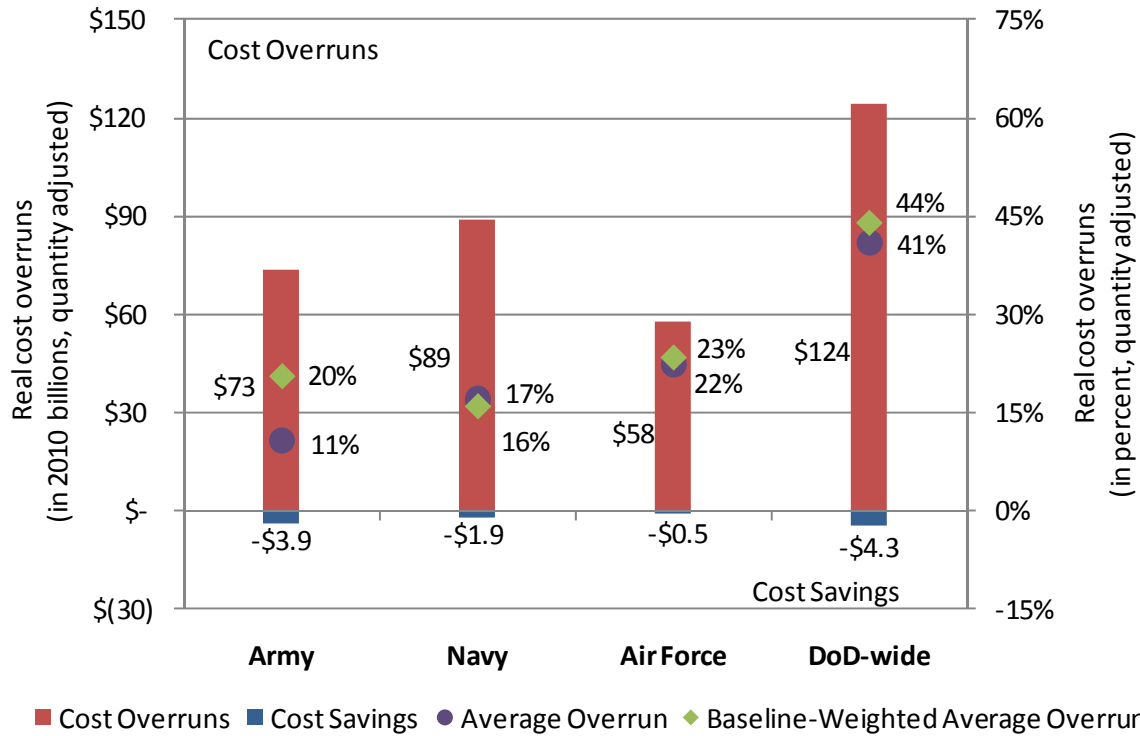
The analysis on the correlation between the lead branch of military service responsible for MDAPs and cost growth patterns reveals that programs led by the Army appear to have fewer, smaller overruns, followed by the Navy and then the Air Force, while DoD-wide programs tend to accrue significant larger cost overruns. The picture alters slightly when utilizing baseline-weighted averages with the Navy showing the least overruns followed by the Army, the Air Force, and DoD-wide programs. The considerable difference for the Army’s results – 11 percent on average versus 20 percent for baseline-weighted averages – is driven by the cancelled Future Combat System. It is important to 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 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)**

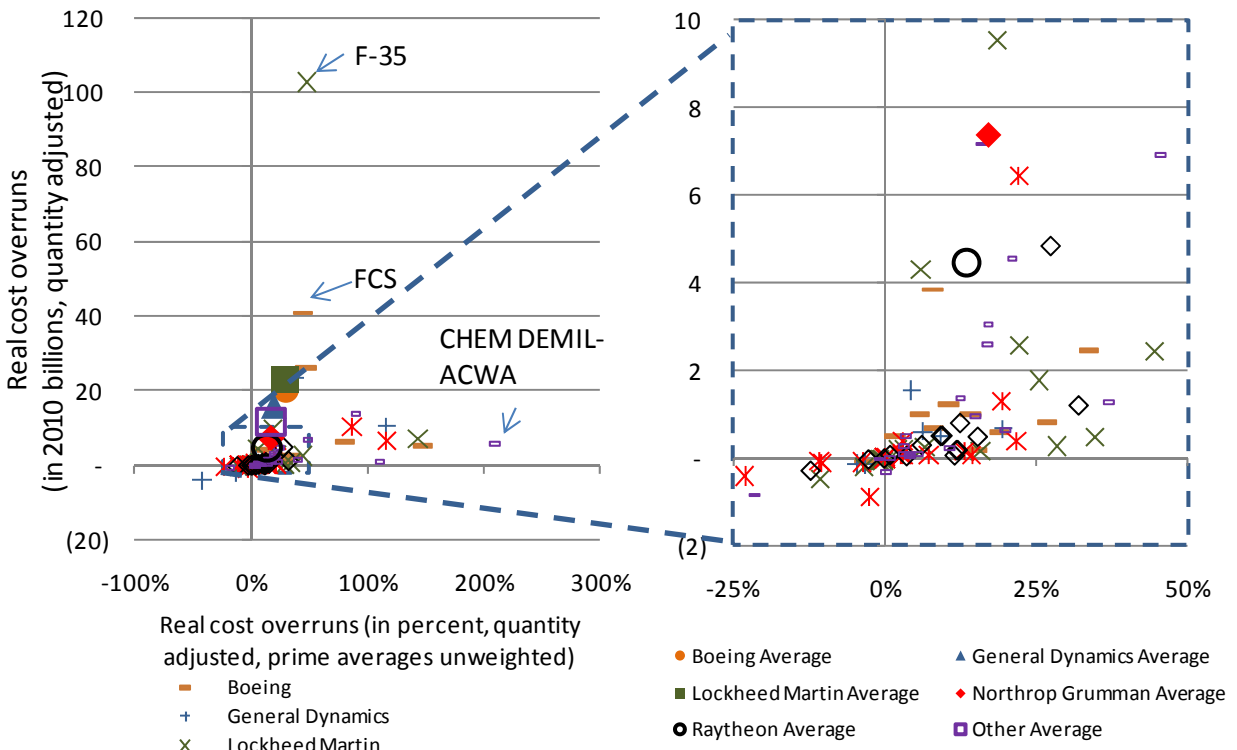


Source: Selected Acquisition Reports; analysis by CSIS Defense-Industrial Initiatives Group

Figure 5 supports the conclusion of the previous chart, with the poorest cost performance in DoD-wide managed MDAPs, while Army and Navy MDAPs, depending on what kind of average is utilized, display the smallest cost overruns. In absolute terms the Air Force shows the lowest total in real cost overruns. Notably, while the Navy performs relatively well on a percentage basis, it also has the largest share of overruns in absolute terms for any of the three service branches. This can be attributed to the size and duration of many Navy programs.

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)**

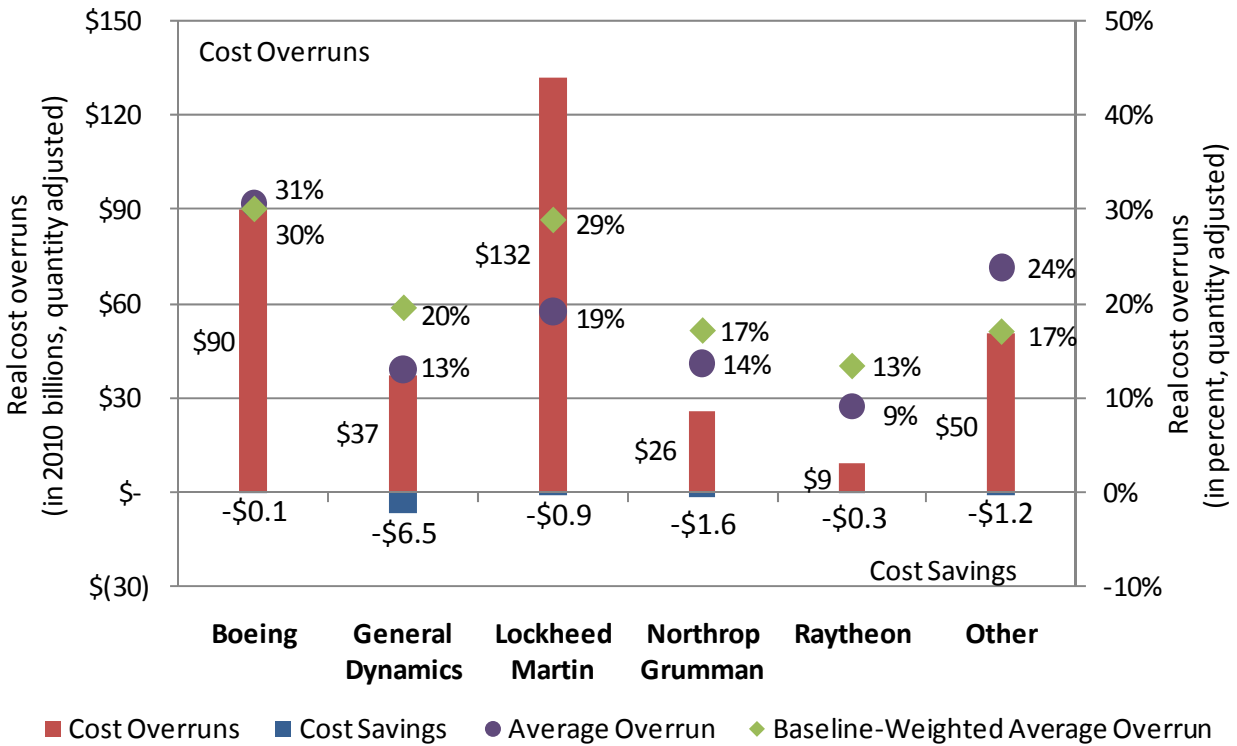


Source: Selected Acquisition Reports; analysis by CSIS Defense-Industrial Initiatives Group

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. Due to a lack of data granularity, the other companies category includes joint ventures and projects that are split between multiple contractor.

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.

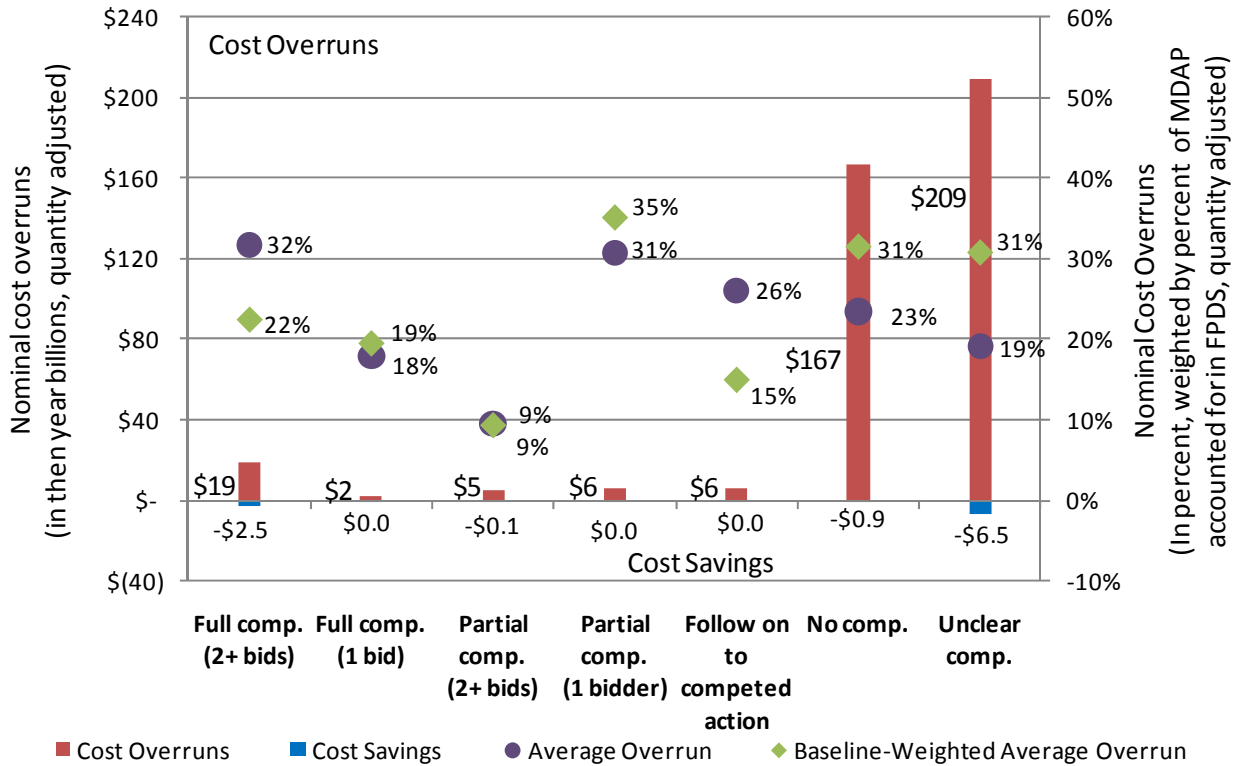
**Figure 7: Cost overruns by prime contractor (II)**



Source: Selected Acquisition Reports; 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 gives reason to be cautious in extrapolating from these results.

**Figure 8: Cost overruns by type of competition**



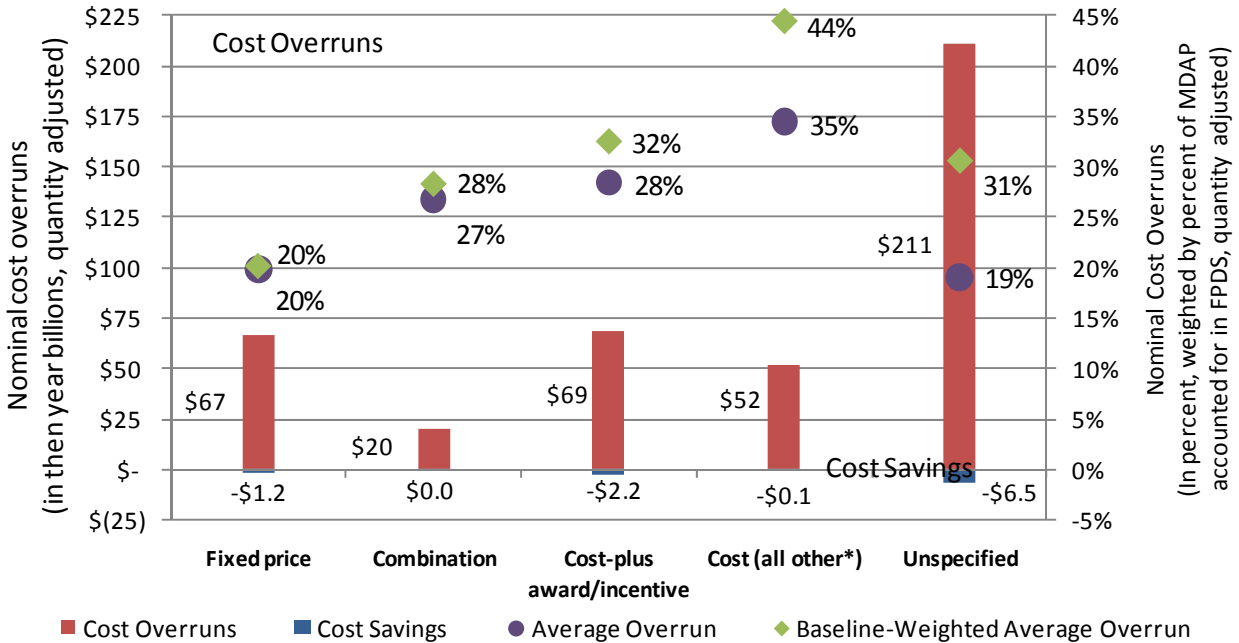
Source: Selected Acquisition Reports; analysis by CSIS Defense-Industrial Initiatives Group

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. This is driven by the comparative scarcity of competed contract dollars in the sample. As a result, when comparing relative cost overrun rates the results are different. Only partial competition<sup>3</sup> with multiple bidders displays a notably better outcome.

Perhaps surprisingly, full and open competition with multiple bidders performs on average worse than no or unclear competition. Only when considering baseline-weighted averages does full and open competition with multiple bidders perform better than no or unclear competition. Based on the SAR’s data, this can be attributed to full and open competition with multiple bidders 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.

<sup>3</sup> 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: Selected Acquisition Reports; 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 on average less cost growth and the cost all other contract types appear to have more, when comparing the share of cost growth and the share of contract value for MDAPs. An interesting finding is the fact that unspecified contract types, while responsible for the majority of cost overruns in absolute terms, perform best when measured based on baseline-weighted averages.

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. The type of fee structure used also appears relevant, as cost-plus award/incentive contracts have lower relative cost growth than all other forms of cost reimbursement contracting, although this is driven in part by the outsized influence of the F-35 project which falls within the cost (all other) category. However, fixed price contracts are more commonly the vehicle of choice for mature technology in full rate production, which are generally considered low risk.

## Findings

This report provides a foundation for future researchers and reformers grappling with the problem of cost overruns in major defense acquisition projects. The results discussed below have been validated by the two most recent Selected Acquisition Reports and together with the underlying data and methodology provide a roadmap for future work.

The strongest correlation with net cost growth is shown in Figure 2: changes in cost estimates are responsible for around 40 percent of the accumulated cost overruns. Of similar importance, Figure 3 shows that the start year has little impact on the compound annual growth rate of cost overruns. This suggests that relatively better performance of newer programs may prove illusory as programs age. Finally, figure 9 shows that fixed price contracts appear to have relatively smaller overruns, although this may tell us more about which programs are likely to receive fixed price contracts rather than what effect fixed price contracts may have on program performance.

There are three logical avenues for future research to build on these results. First, additional factors could be added to the mix to help allocate responsibility to underlying characteristics of an MDAP versus the methods chosen to implement it. Second, the dataset could be steadily expanded to include completed projects and to widen the historical scope and sample size of the project. Third, researchers could examine cost growth throughout the history of a select number of programs and also better control for the effects of updated baselines on older projects. Finally, the government could facilitate all three approaches and enable a range of assessments by allowing outside researchers to access the data that underlies the Selected Acquisition Reports.

Reformers and others studying this issue can take the next step by accessing the data, which will be posted at the Defense-Industrial Initiatives Group website (<http://www.csis.org/diig>) in time for the May 2011 Naval Post-Graduate School conference. The authors intend to stay fully engaged with this issue as the root causes underlying the crisis in MDAP cost growth are being identified and addressed.

## 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.

**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.

**Joachim Hofbauer** is a fellow with the Defense-Industrial Initiatives Group at the Center for Strategic and International Studies (CSIS). He specializes in U.S. and European defense acquisition and industrial base issues and their impact on the transatlantic defense market.

Before joining CSIS, Mr. Hofbauer worked as a freelance defense analyst in Germany and the United Kingdom. His analysis has been published in several U.S. and German defense publications. Mr. Hofbauer holds a B.A. in European studies from the University of Passau and a M.A. with honors in security studies, with a concentration in defense analysis, from Georgetown University.

**Gregory Sanders** is a fellow with the Defense-Industrial Initiatives Group at CSIS, where he gathers and analyzes data on U.S. defense acquisition and contract spending as international defense budgetary and trade trends. He has also studied data visualization and ways to use complex data collections to create succinct and innovative tables, charts, and maps.

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

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**David Morrow** is a research associate with the Defense-Industrial Initiatives Group (DIIG) at CSIS, where he focuses on federal professional services contracting, U.S. naval shipbuilding, and private security contracting. Previously, Mr. Morrow interned at the U.S. Department of State's Office of European Security and Political Affairs and at the U.S.-Russia Business Council. He holds a B.A. in international affairs from James Madison University and an M.A. in European and Eurasian Studies from the George Washington University.



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