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Evidence on the Effect of DoD Acquisition Policy and Process on Cost Growth of Major Defense Acquisition Programs

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Executive Summary

This paper reports the results of research on whether changes in Department of Defense (DoD) acquisition policy and process have had a discernible effect on growth of Program Acquisition Unit Cost (PAUC) of major defense acquisition programs (MDAPs). The analysis is interesting primarily because it sheds some light on and—as it turns out—challenges important assumptions that often are implicit in discussions of acquisition reform.

Acquisition Regime and PAUC Growth

DoD acquisition policy and process over the period Fiscal Year (FY) 1970–FY 2007 can be grouped into five successive regimes:

1. The Defense Systems Acquisition Review Council (DSARC), 1970–1982
2. The Post-Carlucci Initiatives DSARC, 1983–1989
3. The Defense Acquisition Board (DAB), 1990–1993
4. Acquisition Reform (AR), 1994–2000
5. The DAB – Post Acquisition Reform, 2001–2007

The table on page iv displays the average PAUC growth for MDAPs that passed Milestone (MS) II/B or filed a first Selected Acquisition Report (SAR) in each of these regimes. The PAUC growth figures all are measured from the MS II/B baseline and normalized to the MS II/B total inventory objective. There are a number of interesting aspects to these data; for example, the high PAUC growth during the AR period and the lower PAUC growth for FY 2001–FY 2007. Granting that, the single most notable feature of these data is the absence of any trend in PAUC growth. If changes in acquisition policy and process have had a sustained influence on PAUC growth, it does not show up in this table.

Average PAUC Growth in Successive Acquisition Regimes

Acquisition Regime	Time Period	Average PAUC Growth	No. of Observations
DSARC	1970–1982	32%	48
Post Carlucci Initiatives DSARC	1983–1989	19%	40
DAB	1990–1993	36%	11
Acquisition Reform (AR)	1994–2000	66%	27
DAB post AR	2001–2007	19%	25

Broadly, there are two ways to explain the absence of sustained effects of acquisition policy and process on the PAUC growth data. First, they may in fact not have a strong or consistent effect on PAUC growth. Second, acquisition policy and process may have substantial effects that are masked by some other factor or factors.

Funding Climate and PAUC Growth

Thinking along the lines of the second of these possibilities led to consideration of whether changes in the DoD funding climate might be associated with PAUC growth. The period 1970–2007 includes two sub-periods during which acquisition funding was Relatively Constrained: FY 1970–FY 1980 and FY 1987–FY 2002. It also includes two sub-periods in which the acquisition funding climate was more accommodating: FY 1981–FY 1986 and FY 2003–FY 2007. The following table displays the average PAUC growth data for these four sub-periods.

Average PAUC Growth under Different DoD Topline Conditions

Relatively Constrained		Relatively Accommodating	
Period (FY)	**PAUC Growth**	**Period (FY)**	**PAUC Growth**
1970–1980	35% (42)	1981–1986	12% (35)
1987–2002	53% (55)	2003–2007	7% (19)

Note: Numbers in parentheses are the number of observations available.

These data make it clear that MDAPs that passed MS II/B in Relatively Constrained funding climates had far larger PAUC growth than those that passed MS II/B in periods when the funding climate was Relatively Accommodating—by a factor of three in the first comparison and by a factor of five in the second.

Acquisition Regime and Funding Climate

The table on page v expands the table above by replacing the funding climate sub-periods with the acquisition policy and process regimes. This table provides results for two sets of natural experiments. First, the PAUC growth columns give the effect of changes in the acquisition regime for a given funding climate. Second, the rows show the effect of funding climate for a given acquisition regime. For example, the first eleven years of the DSARC (FY 1970–FY 1980) were in a Relatively Constrained funding climate, while the next two (FY 1981–FY 1982) were in a period in which the climate for acquisition funding was Relatively Accommodating.

Average PAUC Growth by Acquisition Regime and Funding Climate

	Relatively Constrained		Relatively Accommodating	
Acquisition Regime	**Period (FY)**	**PAUC Growth**	**Period (FY)**	**PAUC Growth**
DSARC	1970–1980	35% (42)	1981–1982	11% (6)
Post Carlucci DSARC	1987–1989	34% (11)	1983–1986	13% (29)
DAB	1990–1993	36% (11)	None	N/A
Acquisition Reform (AR)	1994–2000	66% (27)	None	N/A
DAB post AR	2001-2002	57% (6)	2003–2007	7% (19)

Note: Numbers in parentheses are the number of observations available.

Statistical analysis of the data behind the averages in this table leads to two conclusions. First, there is no statistically significant improvement or worsening of PAUC growth correlated with the different acquisition policy regimes. This is obvious for the Relatively Accommodating climate (column on the right). In contrast, PAUC growth over FY 1994–FY 2000 and in FY 2001–FY 2002 (column on the left) is noticeably higher than the averages for previous periods, but the differences proved not to be statistically significant because of the large variance among programs in each period.

Second, PAUC growth tends to be substantially higher in a Relatively Constrained funding climate than in the Relatively Accommodating climate. We have only three natural experiments of changes in funding climate for a given acquisition regime, since two of the five acquisition regimes (DAB and AR) fall entirely within one funding climate. Each of these three natural experiments on the effect of funding climate has the same outcome—MDAPs that passed MS II/B in a Relatively Constrained funding climate on average have a much higher PAUC growth rate than those that passed MS II/B in a Relatively Accommodating funding climate for a given acquisition regime. The outcomes of the first two experiments are virtually identical—an average PAUC growth of 35 and 34 percent, respectively, in the two periods when the topline was Relatively Constrained and average PAUC growth of 11 percent and 13 percent, respectively, in the two periods when the topline was Relatively Accommodating. The effect is most pronounced in the third experiment (DAB post-AR), which is statistically significant at the 1 percent confidence level, as are the differences for the DSARC and Post-Carlucci DSARC regimes.

Does the Resource Allocation Process Play a Major Role in PAUC Growth?

These conclusions tend to challenge a fundamental assumption implicit in most discussions of acquisition reform: that the main, although not the only, causes of PAUC growth are to be found in the acquisition realm—the effectiveness of the Program Manager, the adequacy of the developmental test plan, the reasonableness of the cost estimate, the completeness of the systems engineering plan, among many others. This assumption is hard to maintain when the many changes in acquisition policy and process made in the past four decades have not had statistically significant effects on PAUC growth, but there is a statistically significant association between PAUC growth and funding climate.

The association between PAUC growth and funding climate suggests that the resource allocation process, particularly at the Service level, plays an important role in cost growth. This means more than "funding instability." Funding instability is a term of art for changes in MDAP funding through the annual resourcing cycle and "taxes." Funding instability is a chronic condition, present to some degree in all periods. What this paper observes is a recurring pattern—that MDAPs that passed MS II/B during periods when the DoD topline was Relatively Constrained, on average, had much higher PAUC growth than those that passed MS II/B during a period of Relatively Accommodating funding climate.

The conjecture that the resource allocation process plays an important role in cost growth gets some support from an unexpected direction—MDAPs with negative cost growth, of which there are twenty-nine in our sample. Negative PAUC growth is recorded if the actual cost of a program proves to be less than the cost in the MS II/B baseline. Assuming the program was funded to its MS II/B baseline, this implies that over time funds can be taken from the program in question and reallocated to other applications, including other acquisition programs. The program, then, effectively can be used as a "bank"—a way to hold reserves in relative safety until they are needed. A bank of this sort is more likely to be needed in a Relatively Accommodating funding climate, as it can then serve as a way to delay final decisions on the higher level of funding that has become available. We would therefore expect to find relatively more instances of negative PAUC growth in the Relatively Accommodating funding periods, and this is what we observe. About 30 percent of our observations in Relatively Accommodating funding climates are of negative PAUCs, compared to about 12 percent across the periods of Relatively Constrained climate.

MDAPs with "high cost growth," which we define as quantity normalized PAUC growth of at least 50 percent, also suggest an influence from resource considerations. DoD resource managers, particularly at the Service level, have only a few tools for responding to a Relatively Constrained funding climate. One of these is to impose top-down limits on the funding for particular MDAPs as they approach MS II/B. The result is likely to be particularly optimistic programmatic and costing assumptions, which leads to an expectation that relatively more high cost growth programs will be observed in periods of Relatively Constrained funding climate. This is what we observe. During periods of Relatively Constrained funding climate, about 40 percent of MDAPs had very high PAUC growth. In contrast, during periods of Relatively Accommodating funding climate only about 7 percent of MDAPs experienced high PAUC growth.

Taking both funding climates together, 85 percent of MDAPs with PAUC growth of at least 50 percent passed MS II/B during a Relatively Constrained funding climate. These MDAPs had an average PAUC growth of 93 percent and accounted for just over three-quarters of total PAUC growth. Excluding high cost growth MDAPs and MDAPs with negative PAUC growth, average PAUC growth across the two funding climates was just 18 percent. High PAUC growth is then predominantly a feature of programs with PAUC growth of at least 50 percent, and these programs mainly passed MS II/B in periods of Relatively Constrained funding climates. These points are important because they suggest that reforms directed to the average or typical MDAP may miss the real source of the problem.

Implications for Discussions of Acquisition Reform

This paper points to three implications for a discussion of acquisition reform. First, the relevant context for understanding PAUC growth is the interface between the acquisition process and the resource allocation process. The crucial evidence behind this point is the strong association between funding climate and PAUC growth. Resource managers must think in terms of a portfolio of programs across mission areas and commodity types, and extending from efforts in the technology base through programs nearing the end of production. When a program is completed, it opens a resource “hole” that programs emerging from Engineering and Manufacturing Development can occupy. In turn, programs earlier in the acquisition cycle can move forward as well. When funding for acquisition turns down, these holes get smaller, or close entirely, or require cuts in funding for ongoing programs. The alternatives available in this circumstance are all undesirable—cancellations of programs, delays in new starts, stretches, and adoption of unrealistic cost estimates. The evidence suggests that it is in this context that high PAUC growth arises.

Second, it seems unlikely that further broad changes in the acquisition process would have a major effect on PAUC growth. The research found no evidence that the efforts to strengthen the acquisition process through the years have resulted in lower or higher PAUC growth. This does not mean that the DAB process does not provide a useful discipline on acquisition programs; moreover, further changes in acquisition policy or process might be warranted for reasons of good government. The evidence does, at a minimum, suggest that the effects of changes in the acquisition process since its inauguration in the early 1970s have not had a dominant effect on PAUC growth.

Third, it is difficult to see that the cultures of the DoD acquisition organizations are a crucial obstacle to improved performance on cost growth. The key point to note is that high PAUC growth is not persistent, but rather episodic, and correlated with environmental factors outside of the control of the acquisition process. There is remarkably little PAUC growth in periods when the funding is Relatively Accommodating. It seems fair to ask if it makes sense to assert that an entrenched culture sometimes results in high cost growth and other times in low cost growth. Just how is it that the A team takes the field so quickly when the budgetary sun comes out? And why, even in bad budgetary weather, do more than half of MDAPs exhibit comparatively modest PAUC growth?

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Supporting data files provided on CD (inside back cover):

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A. Introduction

This paper reports the results of research on whether changes in Department of Defense (DoD) acquisition policy and process have had a discernible effect on growth of Program Acquisition Unit Cost (PAUC) of major defense acquisition programs (MDAPs). A few previous studies have broached this topic, but it has received little attention, and the work that has been done has not resulted in any accepted or even widely recognized conclusions.[1]

The establishment of the Defense Systems Acquisition Review Council (DSARC) in late Fiscal Year (FY) 1969 marks the start of systematic Office of the Secretary of Defense (OSD) oversight of MDAPs. While an initiative of then Deputy Secretary of Defense David Packard, the DSARC responded to intense congressional concerns with growth in the costs of major DoD weapon system acquisition programs. It appears to have generally been regarded at the time as a successful innovation.

There have been many changes, large and small, in DoD acquisition policy and process since the DSARC was established. Many of these were undertaken simply for reasons of good government—to reduce the costs of the decision-making process and the time it requires, to increase its transparency, to make it more responsive to policy direction, and to adapt it to changes in the technological and national security environment. Many others were aimed directly at improving outcomes on MDAPs—in particular, reducing cost growth. This study was undertaken in the hope that a better understanding of the effects of these changes in acquisition policy and process on PAUC growth will contribute to the long-running discussion of reform of the DoD acquisition process.

Finding or making estimates of PAUC growth for a sufficiently large set of MDAPs was the first major challenge faced by this study. We have a PAUC growth estimate for

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[1] The literature includes many analyses of particular acquisition policies. There also have been several largely qualitative studies of, for example, the extent to which a set of related initiatives has been successful or, to offer another example, the apparent successes and shortcomings of the acquisition process over a specific time period, such as a decade. In contrast, there have been few broad quantitative assessments of the effectiveness of acquisition policy and process. The main predecessors of this work, in particular, are David L. McNicol, *Cost Growth in Major Weapon Procurement Programs*, 2nd edition (Alexandria, VA: Institute for Defense Analyses, 2005), especially pages 41–44 and 55–59, and Tyson et al., "The Effects of Management Initiatives on the Costs and Schedules of Defense Acquisition Programs, Vol. I Main Report," IDA Paper P-2722 (Alexandria, VA: Institute for Defense Analyses, 1992). More recently, Obaid Younossi et al., in *Is Weapon System Cost Growth Increasing? A Quantitative Assessment of Completed and Ongoing Programs* (Santa Monica, CA: The RAND Corporation, 2007), concluded from their careful study of trends in development cost growth that "despite the many acquisition reform and other DoD management initiatives over the years, the development cost growth of military systems has not been reduced." (Summary page xx) References to the previous literature are provided in both McNicol and Younossi.

151 of the 309 distinct MDAPs that filed at least one SAR during FY 1969– FY 2007, a bit less than half of the total. The programs for which we have a PAUC growth estimate do not include any of the approximately seventy-five MDAPs that were terminated with little or no production. It would be interesting to have a reasonable PAUC growth estimate relative to the Milestone (MS) II/B[2] baseline for these programs, but developing such estimates would require far more resources than were available for this study. The study, then, does not provide a comprehensive picture of cost growth; doing so was not its intent. The question asked is whether changes in acquisition policy and process over time have visibly had an influence on PAUC growth. We ask that question for MDAPs that passed MS II/B as Acquisition Category (ACAT) I programs and progressed into full rate production. The question is not explored for programs that were cancelled or truncated.

Appendix A describes the sources of our PAUC growth estimates and puts the MDAPs for which we have a PAUC growth estimate in the context of the entire population of MDAPs. The data we used are included on a compact disc (CD) in a pocket on the inside back cover of this report. Unless stated otherwise, *PAUC growth* here means PAUC growth normalized to the MS II/B baseline quantity.

The second major challenge was one of research design. In broad outline, the paper identifies natural experiments that may shed some light on the effects of acquisition policy on PAUC growth and then interprets the outcomes of those experiments. In part, this is straightforward. We know when the main changes in acquisition policy and process occurred and what they were. The overall DoD acquisition funding climate in various periods—the second main element of the natural experiment—also can be readily established. The problem is that, in addition to the easily identified elements of the natural experimental design, there are a considerable number of other factors that had some influence on PAUC growth. We first limit attention to acquisition regime and funding climate and then, as particular results are stated, ask whether they are compromised by the omission of other factors.

B. Building Blocks

Discussions of acquisition reform over the past twenty-five years have usually put DoD Program Manager (PM) and personnel in the program office in the foreground. These people oversee the contractors and do a myriad of things that must be done by the government for a major acquisition program to move forward—contracting, financial management, and test planning, among many others. In the background are the

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[2] DoDI 5000.2 issued Oct. 23, 2000, formally established Milestones A, B, and C (in place of Milestones I, II, and III) as the main decision points for an MDAP. Milestones A, B, and C began to be used somewhat earlier for new programs, however.

contractors who typically do the development and manufacturing. A good program will not occur if the government personnel and contractors do not do their jobs well. It is equally true that if these individuals and organizations do their jobs well, a good outcome for the program is more likely.

What this focus on the DoD PM, the program office personnel, and the contractors' PMs and workers leaves out are factors they must accept as "givens." These givens are subject to changes—sometimes large and fairly sudden—that presumably have substantial consequences for program outcomes. One of the givens is the topline DoD funding constraint, which does not determine, but generally has a marked influence on, the funding for individual MDAPs. A second is DoD acquisition policy and process. We begin with the latter.

1. Acquisition Regimes

This paper distinguishes five successive DoD acquisition regimes:[3]

1. The Defense Systems Acquisition Review Council (DSARC), 1970–1982
2. The Post-Carlucci Initiatives DSARC, 1983–1989[4]
3. The Defense Acquisition Board (DAB), 1990–1993
4. Acquisition Reform (AR), 1994–2000
5. The DAB – Post Acquisition Reform, 2001–2007 (because our PAUC growth data ends in 2007)

The transition from the first phase of the DSARC (1970–1982) to the second was principally a matter of policy direction and renewal. The thirty-four Carlucci Initiatives (regime number 2) were intended to increase the efficiency and effectiveness of the OSD acquisition oversight process and the Planning, Programming, and Budgeting System (PPBS). While the DAB (number 3) itself bears a strong family resemblance to the DSARC, the statute creating it directed management changes intended to strengthen what is now the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD(AT&L)). This statute also created the position of Vice Chairman of the Joint Chiefs of Staff (VCJCS) and directed a new requirements process centered on the

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3 The main reference we have used is J. Ronald Fox, *Defense Acquisition Reform, 1960 to 2009: An Elusive Goal* (Washington, DC: U.S. Army Center of Military History, 2011). Fox identifies the main features of each of these periods as well as the most important changes that took place within them.

4 After then Deputy Secretary of Defense Frank Carlucci. There is some uncertainty about when the Post-Carlucci Reforms DSARC should end and the DAB regime should begin. The relevant statutes were passed in 1986, and the DAB began functioning under that name in late FY 1987 or early FY 1988; however, DoD did not implement the full set of reforms required by statute until 1990. We have for that reason set the line at 1990.

VCJCS. The results sought by AR (number 4) were improvements in MDAP outcomes, but changes made during that period (not all part of AR) somewhat relaxed OSD oversight of MDAPs. There were, in particular, substantial cuts in acquisition staffs at both the OSD level and Service Headquarters level, and senior decision makers took a more permissive attitude towards cost growth. The Post-AR regime (number 5) was marked by the arrival of a new administration in January 2001, which brought policy changes but no major changes to the acquisition process or statutes.

Table 1 displays the average PAUC growth for MDAPs that passed MS II/B or filed a first SAR in each of these successive regimes. There are a number of interesting aspects to these data; for example, the high PAUC growth during the AR period and the lower PAUC growth for FY 2001–FY 2007. Granting that, the single most notable feature of these data is the absence of any trend in PAUC growth. If changes in acquisition policy and process have had a sustained influence on PAUC growth, it does not show up in this table.

Table 1. Average PAUC Growth in Successive Acquisition Regimes

Acquisition Regime	Time Period	Average PAUC Growth	No. of Observations
DSARC	1970–1982	32%	48
Post Carlucci Initiatives DSARC	1983–1989	19%	40
DAB	1990–1993	36%	11
Acquisition Reform (AR)	1994–2000	66%	27
DAB post AR	2001–2007	19%	25

In constructing Table 1, we assigned the PAUC growth of each program to the acquisition regime in place when the program passed MS II/B or filed its first SAR. At first glance this may seem dubious, since a program can easily take ten or fifteen years from the start of Engineering and Manufacturing Development (EMD) through delivery of the final production lot and thus spend parts of its acquisition cycle under successive acquisition regimes. Note, however, that our estimates are of PAUC growth measured from the baseline established at MS II/B, which does not change over the course of a program's acquisition cycle. It remains possible that the actual acquisition costs of a program are significantly influenced by policy or process changes made after its MS II/B. Evidence presented in Appendix B suggests that if such influences exist, they are much smaller than the effect of the cost estimate in the MS II/B baseline.

Broadly, there are two ways to explain the absence of sustained effects of acquisition policy and process on the PAUC growth data. First, they may in fact not have a strong or consistent effect on PAUC growth. Second, acquisition policy and process may have substantial effects that are masked by some other factor or factors.

2. Funding Climate

Thinking along the lines of the second of these possibilities led to consideration of whether changes in the DoD acquisition funding climate might be associated with PAUC growth. We have a PAUC growth estimate for 151 MDAPs that passed MS II/B or submitted a first SAR during FY 1969–FY 2007. This period includes two sub-periods during which acquisition funding was Relatively Constrained: FY 1970–FY 1980 and FY 1987–FY 2002. We also have two sub-periods in which the acquisition funding climate was Relatively Accommodating: FY 1981–FY 1986 and FY 2003–FY 2007. (We did not include any program not at least five years beyond MS II/B, and the 2012 SARs were the last available for this study.)[5]

Table 2 displays the average PAUC growth data for these four sub-periods. The average PAUC growth in periods of Relatively Constrained acquisition funding is far larger than it is in periods of a Relatively Accommodating funding climate—by a factor of three in the first comparison and by a factor of five in the second.

Table 2. Average PAUC Growth during Different Acquisition Funding Climates

DoD Topline Relatively Constrained		DoD Funding Relatively Accommodating	
Period (FY)	**PAUC Growth**	**Period (FY)**	**PAUC Growth**
1970–1980	35% (42)	1981–1986	12% (35)
1987–2002	53% (55)	2003–2007	7% (19)

Note: Numbers in parentheses are the number of observations available.

What the data in Table 2 portray goes well beyond "budget instability" as usually understood. Budget instability is a term of art for changes in MDAP funding through the annual resourcing cycle and "taxes." Budget instability is a chronic condition, present to some degree in all periods. What this paper observed is a recurring pattern—that MDAPs that passed MS II/B during periods when the acquisition funding was Relatively Constrained, on average, had much higher PAUC growth than those that passed MS II/B during periods of a Relatively Accommodating funding climate.

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5 We use as the breakpoints that define these periods events that marked major changes in expectations about the course of defense spending: (1) The invasion of Afghanistan by the Soviet Union in December 1979 (FY 1980), which about a month later led President Carter to announce a policy of sustained increases in defense spending starting with the FY 1981 funding; (2) the adoption in December 1985 (end of the first quarter of FY 1986) of the Gramm-Rudman-Hollings Act, the funding constraints of which effectively ended the Carter-Reagan defense buildup; and (3) the 9/11/2001attacks. It is important to recognize that key decisions made within DoD on content, costing, and funding for particular MDAPs in a given year are made at least a year in advance of the submission of the funding for that year to the Congress. Consequently, the DoD decisions in funding submissions reflect expectations about the climate that submission will encounter.

C. Statistical Results

Table 3 expands Table 2 by replacing the funding climate sub-periods with the acquisition policy and process regimes. This table provides results for two sets of natural experiments. First, the PAUC growth columns give the effect of changes in the acquisition regime for a given funding climate. Second, the rows show the effect of funding climate for a given acquisition regime. For example, the first eleven years of the DSARC (FY 1970–FY 1980) were in a tight funding climate, while the next two (FY 1981–FY 1982) were in a period in which the acquisition funding climate was Relatively Accommodating.

The two sections that follow discuss, in turn, whether changes in acquisition policy and process have visible effects on PAUC growth, and the association between funding climates and PAUC growth.

Table 3. Average PAUC Growth by Acquisition Regime and Funding Climate

	Relatively Constrained		Relatively Accommodating	
Acquisition Regime	**Period (FY)**	**PAUC Growth**	**Period (FY)**	**PAUC Growth**
DSARC	1970–1980	35% (42)	1981–1982	11% (6)
Post Carlucci DSARC	1987–1989	34% (11)	1983–1986	13% (29)
DAB	1990–1993	36% (11)	None	N/A
Acquisition Reform (AR)	1994–2000	66% (27)	None	N/A
DAB post AR	2001-2002	57% (6)	2003–2007	7% (19)

Note: Numbers in parentheses are the number of observations available.

1. Any Trend in PAUC Growth?

There is no doubt that direction from the Milestone Decision Authority (MDA) changes particular MDAPs, and some of those changes reduce the risks of major PAUC growth or other program performance shortfalls. Viewed from this perspective, the question asked here is whether the decisions made (or not made) in different acquisition regimes are large enough and frequent enough to be visible in average PAUC growth.

Looking first at the Relatively Accommodating climate (column on the right in Table 3) and recognizing that it is likely that the average PAUC growth for FY 2003–FY 2007 eventually will be a few percentage points higher,[6] we can see no trend towards

[6] We have a PAUC growth estimate for nineteen of the twenty-five MDAPs that passed MS B as ACAT I programs during 2003–2007 and which have not been cancelled or truncated. Of these nineteen programs, six have been completed, six are in full rate production (FRP), three are in Low Rate Initial Production (LRIP), and four are in EMD. Younossi et al., in *Is Weapon System Cost Growth Increasing?,* found that on average, 60 percent of development cost growth occurs by five years after

reduction in average PAUC growth in periods with a Relatively Accommodating funding climate. Statistical analysis is consistent with this impression; that is, we found no evidence of statistically significant differences among average PAUC growth rates for the Relatively Accommodating funding climate.[7]

The average PAUC growth rates for the two most recent acquisition regimes during a Relatively Constrained funding (column on the left in Table 3) are noticeably larger than those for the three earlier periods. Again, however, the statistical analysis did not indicate that any of the averages is statistically different from the others at the 1 percent confidence level.

Appendix C presents a table similar to Table 3 for each of the Military Departments and for joint programs. None shows an improving trend in PAUC growth in either of the two funding climates, and with a small number of exceptions, these tables show the same features we see in Table 3.

We have no fully comparable PAUC growth data for the periods before the DSARC was established. Consequently, the statistical analysis leaves open the possibility that the DSARC and its successors provided a useful discipline on acquisition programs.[8] Moreover, the statistical analysis does not erase history. Weapon system cost growth was a particular concern during the 1980s—the sixth Carlucci Initiative was "Funding to Most Likely Costs"—and it is reasonable to believe that the Carlucci Initiatives did in fact lead to more vigorous enforcement of realistic funding. We also know that less emphasis was placed on weapon system cost growth during the AR years, and oversight of acquisition programs was somewhat more relaxed. It could be that these differences do provide part of the explanation for the higher observed average PAUC growth during the AR years. The statistical analysis prevents us from asserting with confidence that they do, however,

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MS B. (31). Estimates of procurement cost growth also usually are increased as necessary to reflect EMD experience. Since each of the nineteen programs is at least five years beyond MS B, even a doubling of the 10 percent average PAUC growth would be unexpected.

7 The method used was one-way analysis of variance (ANOVA). ANOVA is a test of whether three or more samples are drawn from populations with the same mean. The null hypothesis is that all population means are equal; the alternative hypothesis is that at least one mean is different. In this case, the alternative hypothesis was rejected at the 1 percent level. ANOVA assumes that (1) the populations from which the samples were drawn are normally distributed, (2) the samples are independent, and (3) the variances of the populations are equal. We are grateful to Dr. Sarah Burns for her advice on the statistical analysis and for doing the computations.

8 The most nearly comparable data seems to be that in Table A-7 (pp. A-6 to A-8) of Appendix A of Tyson et al., "The Effects of Management Initiatives on the Costs and Schedules of Defense Acquisition Programs, Vol. I: Main Report." These data are quantity adjusted, but for some programs cost growth may not be measured from the estimates at the start of EMD, and the sample may include programs that were cancelled. Omitting one program with an extremely high cost growth (Condor), the average PAUC growth for the pre-1970 MDAPs was 48 percent, which is noticeably higher than the average PAUC growths during 1970–1978.

because those differences are within the bounds of what can be expected from the variability of the data.[9]

It remains possible that factors that have not been considered in this paper mask significant influences of acquisition policy and process on PAUC growth that a more refined analysis would reveal. [10] In considering this possibility, it must be kept in mind that the issue is *growth* in PAUC from the MS II/B baseline not the trend over time in costs for a commodity group or the acquisition portfolio as a whole. Such trends, which may well exist, do not necessarily imply more cost growth for individual programs, as they should be reflected in the MS II/B baselines. Further comments on possible confounding variables are made below. The conclusion offered here is that once we normalize for funding climate we do not observe any improvement in PAUC growth from the changes made over the years in acquisition policy and process.

2. Association of Funding Climate and PAUC Growth

Returning to Table 3 (on page 6) the relevant comparisons are between the Relatively Constrained and Relatively Accommodating funding climates for a given acquisition regime. Whereas the effects on PAUC growth of the different acquisition regimes are elusive, those of the contrasting funding periods stand out sharply.

We have only three experiments of changes in funding climate for a given acquisition regime, since two of the five acquisition regimes (DAB and AR) fall entirely within one funding climate—Relatively Constrained. Each of these three natural experiments on the effect of funding climate has the same outcome—passing MS II/B during a Relatively Constrained funding climate is on average associated with much higher PAUC growth compared to passing during a Relatively Accommodating funding climate for a given acquisition regime. The outcomes of the first two experiments are virtually identical—an average PAUC growth of 35 and 34 percent, respectively, in the two periods when the topline was Relatively Constrained and average PAUC growth of 11 percent and 13 percent, respectively, in the two periods when the topline was

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9 For example, the exceptionally high average PAUC growth during the AR years (66 percent) can be attributed in part to changes in the program mix. During the AR years, four helicopter programs passed MS II/B, one more than average for a period of this length. Moving the helicopter program with the highest PAUC growth (H-1 Upgrades) from 1994–2000 to 1987–1989 reduces the average PAUC growth for the AR years from 66 percent to 61 percent, and increases the average for 1987–1989 from 34 percent to 48 percent.

10 Results of McNicol, *Cost Growth in Major Weapon Procurement Programs*, 2nd edition, point to one possibility—changes in programs that occur after they pass MS II/B. This work considered growth in quantity normalized unit procurement costs after excluding costs of unforced changes in program content (i.e., changes not required to overcome some problem "baked into" the program in the MS II/B baseline). McNicol found evidence that some changes in the acquisition process had had a statistically significant effect on this measure of cost growth. See, in particular, pp. 43–44 and 55–56.

Relatively Accommodating. The effect seems most pronounced in the third experiment (DAB post-AR)—57 percent for FY 2001–FY 2002 and 7 percent for FY 2003–FY 2007. (As noted earlier, PAUC growth for the later period will increase somewhat as the programs of that period are completed; see footnote 7 on page 7.) The statistical analysis found the each of these differences to be significant at more than the 1 percent level.[11]

There is a distinct pattern to the changes in funding climate over our sample period—bust, boom, bust, boom. If some other factor or combination of factors is actually at work, rather than funding climate, it would have to have this same pattern. One possibility is that the methods used to estimate PAUC growth for MDAPs that passed MS II during FY 1989–FY 2007 are not the same as the method used for those that passed MS II during FY 1970–FY 1988. The limited evidence we have on this possibility is presented and discussed in the section in Appendix A entitled "Comparison of the PA&E and CLC PAUC Growth Estimates" (page A-7). It suggests that differences in estimating methods do not explain the low average PAUC growth recorded for FY 2003–FY 2007 or the comparatively high cost growth observed for FY 1990–FY 2002. The obvious interpretation of Table 3, and the one we believe to be correct, is that it really is changes in funding climate at work.

This does not mean that a Relatively Constrained funding climate causes PAUC growth. The proximate causes of PAUC growth are decisions embedded in programs approved at MS II/B (unrealistic cost estimates or programmatic assumptions, for example) and decisions made during program execution (such as failing to act promptly enough on test results) that eventually lead to PAUC growth. The correlation observed between higher PAUC growth and periods of tighter funding climate observed does suggest that programs are more likely to be burdened with such decisions if they passed MS II/B during a Relatively Constrained funding climate.

D. Is High PAUC Growth Systemic in the Relatively Constrained Funding Climate?

Based on the analysis thus far, it would not be surprising to find that almost all programs that pass MS II/B during a period with a Relatively Constrained funding climate are burdened with the sorts of very optimistic programmatic and costing assumptions that tend to result in high PAUC growth. Alternatively, the bulk of the cost growth might be accounted for by a relatively small number of MDAPs. Which of these two cases is the more nearly accurate is relevant to discussion of acquisition reform. In the first case it is reasonable to assume that PAUC growth is a systemic problem. It is often said, for example, that the acquisition culture has a bias in favor of optimistic

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[11] In this case we used the usual one-tail test for the difference between the means of samples drawn from what are assumed to be normal populations.

programmatic and cost assumptions. PAUC growth looks much less like a systemic problem with the acquisition process, however, if most of it is due to a small number of MDAPs.

The first column of Table 4 shows the average PAUC growth (in periods of Relatively Constrained funding climate) of MDAPs that had a PAUC growth between zero and 50 percent. The average for these MDAPs was a PAUC growth of about 22 percent. The second column shows the average PAUC growth of those MDAPs that experienced a PAUC growth of at least 50 percent. These range from a low of 71 percent (FY 1970–FY 1980) to a high of 122 percent (FY 1994–FY 2000). The average of these values is 94 percent. Finally, the last column in Table 4 shows the *percentage* of PAUC growth in these periods accounted for by MDAPs with PAUC growth of at least 50 percent. The range is 62 percent to 89 percent and, averaged across all five periods, the high cost growth MDAPs accounted for just over three-quarters of total PAUC growth. (The figures shown in Table 4 are computed from simple averages rather than weighted by program size.[12]) In short, PAUC growth is mainly an affliction of Relatively Constrained funding climates and it is primarily due to a minority of programs—on the order of 37 percent—that experience PAUC growth of upwards of 50 percent.

Table 4. Characteristics of PAUC Growth in Relatively Constrained Funding Climate

Acquisition Regime	Period (FY)	Average PAUC Growth of MDAPs with PAUC Growth between 0% and 50%	Average PAUC Growth of MDAPs with PAUC Growth ≥ 50%	% of PAUC Growth Accounted for by MDAPs with PAUC Growth ≥ 50%
DSARC	1970–1980	21% (22)	71% (15)	73%
Post Carlucci DSARC	1987–1989	22% (7)	117% (2)	62%
DAB	1990–1993	21% (7)	84% (3)	64%
Acquisition Reform	1994–2000	22% (10)	122% (13)	89%
DAB post AR	2001–2002	29% (3)	85% (3)	75%

Note: Numbers in parentheses are the number of observations.

12 Weighting by program size would be required in any consideration of the effect of PAUC growth on funding, because cost growth on a large program has a greater effect on funding requirements than cost growth of the same magnitude on a smaller program. This paper, however, is concerned with examining the extent to which PAUC growth is associated with particular combinations of acquisition regimes and funding climates and in such a context, each observation counts as much as any other.

E. Does the Resource Allocation Process Play a Major Role in PAUC Growth?

This section turns to a discussion of MDAPs that experienced very high cost growth (interpreted as a PAUC growth of at least 50 percent) and MDAPs that experienced negative cost growth. Investigation of this topic was initially prompted by the prospect that instances of high cost growth and perhaps also of negative cost growth mask effects of acquisition policy and process on PAUC growth. The topic proves to be interesting for other reasons as well. First, it provides clear and unexpected evidence of the connection between PAUC growth and funding climate and, by implication, the DoD resource allocation process. Second, cost growth proves not to be a problem with the typical system but with the minority of MDAPs that experience very high cost growth.

1. Negative PAUC Growth

Twenty-nine MDAPs in our sample show negative PAUC growth (not including four cases of zero PAUC growth). Viewed from an acquisition perspective, negative PAUC growth seems anomalous; in fact, it is not uncommon to hear confident assertions to the effect that MDAPs never underrun their funding. It is understandable, however, in a resource allocation context at the Service level.

Negative PAUC growth is recorded if the actual cost of a program proves to be less than the cost in the MS II/B baseline. Negative PAUC growth can occur because a program was particularly well managed or lucky. It also can occur if the ambitions of a program are scaled back after a program has passed MS II/B. In addition, negative PAUC growth can grow out of resource allocation imperatives.

Assuming the program was funded to its MS II/B baseline, negative PAUC growth implies that over time funds can be taken from the program in question and reallocated to other applications, including other acquisition programs. The program, then, effectively can be used as a "bank"—a way to hold reserves in relative safety until they are needed. A "withdrawal" can be made in the execution year with the approval of the Congress, but for the outyears of the Future Years Defense Plan (FYDP), the Service can simply initiate the reallocation in its Program/Funding submission to OSD.

A bank of this sort is more likely to be needed in a Relatively Accommodating funding climate, as it can then serve as a way to delay final decisions on allocation of the higher level of funding that has become available. We would therefore expect to find relatively more instances of negative PAUC growth in the Relatively Accommodating funding periods, and this is what we observe. As the data in Table 5 indicate, about 30 percent of our observations in Relatively Accommodating funding climates are of negative PAUCs, compared to about 12 percent across the periods of Relatively Constrained climate.

Table 5. Number of PAUC Growth Observations less than Zero
***by Acquisition Regime and* Funding Climate**

Acquisition Regime	Topline Relatively Constrained		Topline Relatively Accommodating	
	Time Period (FY)	PAUC Growth < 0	Time Period (FY)	PAUC Growth < 0
DSARC	1970–1980	5 of 42	1981–1982	2 of 6
Post Carlucci DSARC	1987–1989	2 of 11	1983–1986	10 of 29
DAB	1990–1993	1 of 11	None	N/A
Acquisition Reform (AR)	1994–2000	4 of 27	None	N/A
DAB post AR	2001–2002	0 of 6	2003–2007	5 of 19

Negative PAUC growth is not regarded as a problem, probably correctly. It is, however, a clear and unexpected case in which PAUC growth reflects accommodation to the funding climate.

2. PAUC Growth ≥ 50 Percent

Adoption of unrealistically low cost estimates at MS II/B creates the illusion that the funds available over the FYDP and beyond will support more MDAPs than they in fact will. That is, unrealistically optimistic costing will for a time permit more new starts.[13] In addition, the conventional wisdom holds that a lower MS II/B cost makes it easier to gain the concurrence of OSD, the Office of Management and Budget, and the Congress for a new program. Consequently, we would expect to find relatively more programs with PAUC growth of at least 50 percent in Relatively Constrained funding climates, which is in fact what we do find.

Table 6 reports the number of programs with an average PAUC growth of at least 50 percent. Of the fifty-four programs that passed MS II/B in a Relatively Accommodating funding climate, only four showed PAUC growth of at least 50 percent. In contrast, thirty-six of the ninety-seven programs that passed MS II/B in a Relatively Constrained funding climate showed cost growth of at least 50 percent. This is to say that the frequency of MDAPs with a PAUC growth of at least 50 percent is much lower in periods when the topline is Relatively Accommodating than in a Relatively Constrained funding climate—7 percent versus 37 percent.

[13] It is not clear that doing this ever makes financial sense because the "loans" created by unrealistically low cost estimates eventually must be made good one way or another at an implicit but steep interest rate.

Table 6. Number of PAUC Growth Observations ≥*50%* *by Acquisition Regime and* Funding Climate

	Topline Relatively Constrained		Topline Relatively Accommodating	
Acquisition Regime	Time Period (FY)	PAUC Growth ≥50%	Time Period (FY)	PAUC Growth ≥50%
DSARC	1970–1980	15 of 42	1981–1982	0 of 6
Post Carlucci DSARC	1987–1989	2 of 11	1983–1986	3 of 29
DAB	1990–1993	3 of 11	None	N/A
Acquisition Reform (AR)	1994–2000	13 of 27	None	N/A
DAB post AR	2001–2002	3 of 6	2003–2007	1 of 19

3. Reexamination of Trends in PAUC Growth

The circumstances in which we are more likely to see very high PAUC growth and instances of negative PAUC growth suggest that they reflect accommodations to different funding climates. In other words, instances of high PAUC and negative PAUC may not reflect the normal operation of the acquisition process. On this basis, Table 7 presents average PAUC growths computed excluding observations of greater than or equal to 50 percent and negative values.

The statistical analysis of the data in Table 7 produces the same conclusions as that of Table 3 in one important respect: there is no indication of statistically significant differences across acquisition regimes within a funding climate. The difference between the averages in the two funding climates for the DAB post AR is, however, statistically significant at the 1 percent level, but the differences for the other two cases (DSARC and Post-Carlucci DSARC) are not statistically different at conventional levels of significance.

Table 7. Average PAUC Growth Excluding Observations ≥50 Percent and Negative Observations *by Acquisition Regime and* Funding Climate

	Topline Relatively Constrained		Topline Relatively Accommodating	
Acquisition Regime	Time Period (FY)	% of PAUC Growth	Time Period (FY)	% of PAUC Growth
DSARC	1970–1980	21% (22)	1981–1982	22% (4)
Post Carlucci DSARC	1987–1989	22% (7)	1983–1986	13% (16)
DAB	1990–1993	21% (7)	None	N/A
Acquisition Reform (AR)	1994–2000	22% (10)	None	N/A
DAB post AR	2001–2002	29% (3)	2003–2007	10% (13)

Note: Numbers in parentheses are the number of observations.

F. Implications for Discussions of Acquisition Reform

This paper points to three implications for a discussion of acquisition reform. First, the relevant context for understanding PAUC growth is the interface between the acquisition process and the resource allocation process. The crucial evidence behind this point is the strong association between funding climate and PAUC growth. Resource managers must think in terms of a portfolio of programs across mission areas and commodity types, and extending from efforts in the technology base through programs nearing the end of production. When a program is completed, it opens a resource "hole" that programs emerging from EMD can occupy. In turn, programs earlier in the acquisition cycle can move forward as well. When funding for acquisition turns down, these holes get smaller, or close entirely, or require cuts in funding for ongoing programs. The alternatives available in this circumstance are all undesirable—cancellations of programs, delays in new starts, stretches, and unrealistic costing. The evidence summarized here suggests that it is in this context that high PAUC growth arises.

Second, it seems unlikely that further changes in the acquisition process would have a major effect on PAUC growth. The research found no evidence that acquisition policy and process changes through the years have produced sustained and significantly lower or higher PAUC growth. This does not mean that the DAB process does not provide a useful discipline on acquisition programs; moreover, further changes in acquisition policy or process might be warranted for reasons of good government. The evidence does, at a minimum, suggest that the effects of changes in the acquisition process since its inauguration in the early 1970s have not had a dominant effect on PAUC growth.

Third, it is difficult to see that the cultures of the DoD acquisition organizations are a crucial obstacle to improved performance on cost growth. The key point to note is that high PAUC growth is not persistent, but rather episodic, and correlated with environmental factors outside of the control of the acquisition process. There is remarkably little PAUC growth in periods when the funding is Relatively Accommodating. It seems fair to ask if it makes sense to assert that an entrenched culture sometimes results in high cost growth and other times in low cost growth. Just how is it that the A team takes the field so quickly and quietly when the budgetary sun comes out? And why even in bad budgetary weather do more than half of MDAPs exhibit comparatively modest PAUC growth?

Appendix A.
The Data

All of the data used in this study were taken directly or indirectly from SARs. Broadly, two sorts of data are required. The first is MS II/B baseline data for each MDAP, especially the PAUC and the inventory objective, or total quantity to be acquired. Second, we need the same data from the final SAR filed by an MDAP, or for programs still underway, the Current Estimate (CE) from the December 2012 SAR. Our PAUC growth estimates reflect the actual PAUC (or the most recent CE) normalized to the MS II/B quantity and divided by the MS II/B PAUC. They are, in short, as close as we can get to actual (quantity normalized) PAUC growth.

The first section of this appendix (The Population and the Sample) contains an overview of the sample of MDAPs for which we were able to obtain PAUC growth estimates and its relationship to the complete population of MDAPs. The second section of this appendix (PAUC Growth Estimates), beginning on page A-5, describes in detail the PAUC estimates used.

The Population and the Sample

The "stretch goal" of this paper was to identify all MDAPs that have ever filed a SAR and are at least five years into EMD, and to find a PAUC growth estimate relative to the MS II/B baseline for each of these programs. As is discussed in what follows, neither of these objectives was fully achieved.

Memo Entries

This research started with the list of programs that have filed at least one SAR implicit in the Defense Acquisition Management Information Retrieval System (DAMIRS) and a set of SARs available on an Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics) (OUSD(AT&L)) SIPRNet website. Together, these provide SARs under 345 distinct labels.

Not all of these were really distinct MDAPs, however:

- In several instances, each of the Services involved in a Joint program annually filed separate SARs, which, apart from some administrative information, were identical to each other.
- In some instances, separate MDAPs were merged into a single MDAP.

- Conversely, there were instances in which a single MDAP was divided into two or more separate programs.
- The initial list included a number of instances in which a single MDAP appeared (usually in different years) under different names.
- A few of the items in the initial list are not MDAPs but Major Automated Information System (MAIS) programs.
- We found programs that filed a SAR after passing MS I but was cancelled before passing MS II. We also found a program (Patriot P3I) that filed only one SAR and was, in the next year, absorbed into the Patriot Advanced Capability-3 (PAC-3) program.
- Ballistic missile defense programs appear on the initial list under three different labels. In each case, the label covers a set of systems, not a single MDAP.
- The initial list included four chemical demilitarization programs. These are MDAPs, but the pressures on them and considerations that go into funding decisions on them mark them out as significantly different from major weapon system acquisition programs.

Most of these situations have a straightforward resolution. Duplicates, for example, clearly should not be in the main database, and whether the chemical demilitarization programs and the various incarnations of strategic missile defense are included is a matter of judgment. We excluded both and also excluded MAIS programs. Mergers and separations, in contrast, can be problematic. The guideline applied in these cases was as follows: Enter each program into the main database only once and, for mergers and separations, the default option is the program(s) that received MS II/B approval.

The thirty-six labels that appeared on the initial list of 345 and that were not included in the database were retained in a separate listing as "memo entries." The remaining 309 MDAPs are the population considered in this study. The CD provided with this paper (see the pocket on the inside back cover) provides both the main database (Table A-1) and the memo entries (Table A-2).

Coverage

We have an estimate of PAUC relative to MS II/B for 151 of the 309 MDAPs in our database—a bit less than half. Although accurate, this comparison leaves out an important point. Approximately seventy-five of the 309 MDAPs were cancelled (i.e., terminated before going into production) or truncated (i.e., terminated with little or no production beyond LRIP). Of the 228 MDAPs that eventually progressed into production, we have cost estimates for about two-thirds.

It would be interesting to have a reasonable PAUC growth estimate relative to the MS II/B baseline for the programs that were cancelled or truncated, but developing such estimates would require far more resources than were available for this paper.[1] The paper, then, does not provide a comprehensive picture of cost growth. Doing so was not its intent. The question asked was whether changes in acquisition policy and process over time have visibly had an influence on PAUC growth. We asked that question for MDAPs that passed MS II/B as ACAT I programs and progressed into full rate production. The question is not explored for programs that were cancelled or truncated or that passed MS II/B as ACAT II or ACAT III programs.

Table A-3 presents data on our coverage of Army, Navy/USMC, USAF, and Joint programs for FY 1969–FY 1974, FY 1975–FY 1988, FY 1989–FY 2001, and FY 2002–FY 2007. Note that coverage is defined as the percentage of programs with a PAUC growth estimate divided by the number of programs that had significant production—that is, programs that were not cancelled or truncated.

For FY 1969–FY 1974 and FY 1975–FY 1988, programs were selected by the Office of Program Analysis and Evaluation (PA&E) to provide a representative coverage of MDAPs. It appears that PA&E was reasonably successful in doing so, although Joint programs are distinctly under-represented for FY 1969–FY 1974, and USAF programs are over-represented. The situation is much improved for FY 1975–FY 1988. The coverage ratios range from a low of about 63 percent for the Navy/USMC and a high of 92 percent for Joint programs.

The coverage ratios range from 59 percent to 94 percent for FY 1989–FY 2001 and 40 percent to 82 percent for FY 2002–FY 2007. The programs in these periods without PAUC growth estimates fall into two categories:

- Programs that passed MS II/B as ACAT II or ACAT III programs and later became ACAT I programs.
- Programs that passed MS II/B as ACAT I programs but were subsequently reorganized in a way that makes tracking the restructured program back to the MS II/B baseline difficult.

[1] It is commonly assumed that there is a close association between PAUC growth and program cancellation or truncation. As a careful look at the data will show, high PAUC growth is neither a necessary nor a sufficient condition for an MDAP to be cancelled or terminated. Space-Based Infrared System (SBIRS)-High, for example, had an exceptionally high PAUC growth, but as of the December 2012 SAR, its planned acquisition quantity remained at 80 percent of the Milestone II baseline. In contrast, the Joint Standoff Weapon (JSOW) PAUC normalized to the MS II quantity *decreased* by 14 percent, yet (again as of the December 2012 SAR) the planned acquisition quantity was only 38 percent of the MS II baseline.

The second of these problems could be overcome at least in some cases with sufficient effort, but the first probably cannot, because the data required cannot readily be obtained and, in fact, may no longer exist.

Table A-3. PAUC Growth Estimates as a Percentage of the Number of MDAPs for Which a PAUC Growth Estimate Could Be Made

		FY 1969–FY 1974	FY 1975–FY 1988	FY 1989–FY 2001	FY 2002–FY 2007
Army	MDAPs	15	30	23	8
	Cancellations and truncations	4	7	7	3
	Net: PAUC growth estimate feasible	11	23	16	5
	Number of MDAPs with PAUC growth estimate	4	18	15	2
	Coverage	**36%**	**78%**	**94%**	**40%**
USN/USMC	MDAPs	23	45	25	14
	Cancellations and truncations	1	10	3	3
	Net: PAUC growth estimate feasible	22	35	22	11
	Number of MDAPs with PAUC growth estimate	6	22	13	9
	Coverage	**27%**	**63%**	**59%**	**82%**
USAF	MDAPs	16	31	20	10
	Cancellations and truncations	1	9	5	3
	Net: PAUC growth estimate feasible	15	22	15	7
	Number of MDAPs with PAUC growth estimate	6	15	12	5
	Coverage	**40%**	**68%**	**80%**	**71%**
Joint	MDAPs	6	17	12	12
	Cancellations and truncations	2	5	4	5
	Net: PAUC growth estimate feasible	4	12	8	7
	Number of MDAPs with PAUC growth estimate	1	11	7	5
	Coverage	**25%**	**92%**	**88%**	**71%**

PAUC Growth Estimates

As was noted above, this study obtained or made estimates of PAUC growth for 151 MDAPs that passed MS II/B as ACAT I programs during the years FY 1969–FY 2007. These different sources and methods are described in what follows.

PA&E Cost Growth Database (PA&E)

PA&E, now the Office of Cost Analysis and Program Evaluation, developed a database of cost growth experienced by MDAPs. This database is documented in a briefing by John McCrillis given at the 2003 Annual DoD Cost Analysis Symposium.[2] (The CD included with this paper includes this briefing.)

The earliest cost estimates in the PA&E database are from MDAPs that passed MS II in 1970, and the latest are for programs that passed MS B in FY 2001. The MDAPs in the PA&E database were last updated using the December 2004 SARs. The PA&E cost growth database included PAUC growth estimates for 93 MDAPs that were completed (that is, filed their last SAR) in FY 2004 or earlier. The other PAUC growth estimates in the PA&E database had to be updated—which we did not have the data or resources to do—or replaced with a PAUC growth estimate made in some more summary fashion.

No Quantity Change (NQC)

The CE quantity was within ± 1 percent of the MS II/B quantity for thirteen of the MDAPs from FY 1989–FY 2007. No quantity normalization is needed for these programs; their PAUC growth is computed by dividing the CE PAUC in the final SAR (or the December 2012 SAR for an ongoing program) by the MS II/B PAUC and subtracting 1. The PAUC growth for SBIRS-High (H) also falls under this heading. The total number of SBIRS-H satellites to be acquired decreased from five (at MS II) to four (the December 2012 SAR). The decrease, however, was in a satellite purchased with Research, Development, Test and Evaluation (RDT&E) funds, and we did not put these on a learning curve. There was no change in the number of SBIRS-H satellites purchased with procurement funds. Finally, although the PAC-3 quantity change fell outside the ± 1 percent boundary, data limitations made it necessary to compute the PAC-3 PAUC growth as the ratio of the CE and MS II PAUCs. The relevant data for the NQC computations are included on the NQC worksheet in Table A-4 on the CD. The letters in the computation box at the top of the worksheet refer to the column headings for the data.

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2 Accessible at https://dodcas.deltaresources.com/DODCAS%20Archives /36th%20DODCAS%20%282003%29/Theme%20-%20Evolutionary%20Acquisition/McCrillis.pdf.

DAMIRS Learning Curves (DLC)

The DoD contractor staff for DAMIRS provided us with their estimates of learning curve parameters that we were able to use to compute PAUC growth for fourteen MDAPs that passed MS II/B during FY 1989–FY 2001. We refer to these as the DAMIRS Learning Curve (DLC) PAUC growth estimates. For each of these, we took the CE PAUC growth in program base-year dollars from the last SAR for the program or the December 2012 SAR (for still ongoing programs). The task was to normalize this PAUC estimate to the MS II/B quantity, which was done as follows:

- We used the learning curve to compute the recurring flyaway cost at the MS II/B baseline quantity.
- The CE estimates of RDT&E and non-recurring flyaway cost were taken from the final SAR for the program or from the December 2012 SAR (for still on-going programs).
- Support costs paid for with procurement dollars are, for many programs, primarily initial spares and support equipment, although other items may also fall into this category. Initial spares and support equipment normally scale with the number of units of the system purchased. For that reason, we used CE support cost reported in the last or most recent SAR scaled to the MS II/B baseline quantity.

The computations and the data used are laid out on the DLC worksheet in Table A-4 on the CD provided with this paper. The letters in the computation box at the top of the worksheet refer to the column headings for the data.

Calibrated Learning Curve (CLC)

There were twenty-nine MDAPs for which we did not have a PA&E estimate and did not have estimated learning curve parameters, and for which the CE quantity was significantly different from the MS II/B quantity. The approach we used in those cases rested on a cost progress curve of the conventional form:

$$C = TQ^{\beta} \tag{1}$$

In this expression, C is recurring flyaway cost, T is first unit cost, Q is cumulative production, and β is the cost progress parameter. We solved this and used the CE for recurring flyaway to get:

$$\hat{T} = CQ^{-\beta} \tag{2}$$

A value of β = 0.94 was used for each of the programs. This will be referred to as the calibrated learning curve (CLC) method. From this point, the computations were the same as those for MDAPs for which DAMIRS staff provided the learning curve parameters.

The CLC worksheet in Table A-4 on the CD provides the data used in making the computations and indicates the details of the computations. The letters in the computation box at the top of the worksheet refer to the column headings for the data.

Summary

Table A-5 below provides a summary of the sources of the PAUC growth estimates for three different periods (which were marked off only for convenience in assembling the data). Table A-1 on the CD identifies the source of each estimate.

Table A-5. Sources of the PAUC Growth Estimates Used in Different Periods

Period (FY)	PA&E	NQC*	DLC	CLC	Total
1970–1988	83	0	0	0	83
1989–2001	10	6	14	17	47
2002–2007	0	8	0	13	21
Total	**93**	**14**	**14**	**30**	**151**

* No Quantity Change (i.e., CE quantity with ± 1 percent of the MS II/B quantity.)

Comparison of the PA&E and CLC PAUC Growth Estimates

The data in Table A-5 suggest the question of whether the results are influenced significantly by the different ways in which PAUC estimates are made. This is primarily a question about FY 2002–FY 2007, which has a notably low average PAUC growth (10 percent) and for which about two-thirds of the PAUC growth estimates were made with the CLC method. It is secondarily a question about FY 1989–FY 2001 in relation to FY 1970–FY 1988. In the earlier period, all of the PAUC growth estimates were from PA&E, while in the later, about two-thirds were made using either the DLC or the CLC method.

The obvious approach to this issue is to compare the PA&E PAUC growth for systems that have been completed with PAUC growth for those same systems computed using the DLC and the CLC methods. Unfortunately, there are no MDAPs that have been completed and for which we have both a PA&E PAUC growth estimate and the data needed to compute a DLC or an CLC estimate.

The best we can do is to examine the twenty-three MDAPs that passed MS II/B during FY 1989–FY 2001 and for which we have a PA&E PAUC growth estimate, a DLC estimate, and a CLC estimate. As was noted above, the PA&E estimates were most recently updated with the 2004 SARs. The DLC and CLC estimates, in contrast, incorporated more recent data—either the final SAR for the program or, for ongoing programs, the December 2012 SAR. Consequently, in most cases we would expect the DLC and CLC PAUC growth estimates to be larger than the corresponding PA&E estimate. That is the test: A method fails if it yields estimates that are “too often” and by “too much” less than the PA&E estimates. Clearly, this is a weak test.

The relevant estimates are presented in Table A-6 on page A-9. The comparison of the PA&E estimates and CLC estimates is on the left, and the comparison of the PA&E and DLC estimates is on the right. The CLC estimates are larger than the PA&E estimates for seventeen of the twenty-three MDAPs—in most cases, considerably larger. They are smaller in six cases (shaded rows). In all but one of these cases (Joint Direct Attack Munition, or JDAM) the differences are absolutely or relatively small. The average of CLC PAUC growth estimates is 77 percent in comparison to an average of 60 percent for the PA&E estimates. The DLC estimates exhibit the same pattern. The average of the DLC estimates is 73 percent, and four of them (shaded rows) are less than the PA&E estimate for the program, three by a substantial amount.

Table A-6. Comparison of PA&E, CLC, and DLC PAUC Growth Estimates for 23 MDAPs

Program	PA&E	CLC	Program	PA&E	DLC
LONGBOW APACHE	78%	117%	LONGBOW APACHE	78%	133%
F-22	41%	71%	F-22	41%	55%
F/A-18E/F	6%	12%	F/A-18E/F	6%	9%
BRADLEY UPGRADE	39%	54%	BRADLEY UPGRADE	39%	86%
MIDS	30%	72%	MIDS	30%	68%
CEC	48%	62%	CEC	48%	62%
H-1 UPGRADES	124%	192%	H-1 UPGRADES	124%	197%
LPD 17	43%	71%	LPD 17	43%	72%
CH-47F	147%	173%	CH-47F	147%	156%
GMLRS/GMLRS AW	125%	249%	GMLRS/GMLRS AW	125%	243%
MH-60S	62%	69%	MH-60S	62%	70%
Tactical Tomahawk	24%	28%	Tactical Tomahawk	24%	27%
GBS	10%	31%	GBS	10%	33%
Stryker	21%	25%	Stryker	21%	22%
UH-60M Black Hawk	49%	62%	UH-60M Black Hawk	49%	61%
WGS	28%	55%	WGS	28%	42%
C-130J	70%	84%	C-130J	70%	70%
JPATS	43%	40%	JPATS	43%	44%
SSN 774	35%	33%	SSN 774	35%	37%
JDAM	18%	-10%	JDAM	18%	-13%
JAVELIN	229%	197%	JAVELIN	229%	134%
MH-60R	95%	74%	MH-60R	95%	80%
NAS	25%	21%	NAS	25%	1%
Average	**60%**	**77%**		**60%**	**73%**

Note: The PA&E estimates were updated only through the 2004 SARs. The CLC and DLC estimates incorporate information from the last SAR for the program or the December 2012 SAR (for still ongoing programs).

Appendix B.
Evidence on the Influence of the Funding Climate Prevailing at MS II/B on PAUC Growth

As was noted in the main body of this paper (page 4), the PAUC growth of each program is assigned to the acquisition regime/funding climate in place when the program passed MS II/B or filed its first SAR. The extent to which this is reasonable is not immediately clear. On the one hand, a program can easily take ten or fifteen years from the start of EMD through delivery of the final production lot and thus spend part of its acquisition cycle under successive acquisition regimes. On the other hand, our estimates are of PAUC growth measured from the baseline established at MS II/B. This does not change over the course of a program's acquisition cycle, and to the extent that the main causes of cost growth are "baked into" the MS II/B baseline, we would not expect subsequent changes in funding climate or acquisition regime to have a major effect on PAUC growth.

This appendix presents evidence that bears on whether the actual acquisition costs of a program are significantly influenced by policy or process changes made after its MS II/B.

Case 1 in Table B-1 compares the FY 1970–FY 1972 cohort with that of FY 1978–FY 1980. A program that passed MS II in 1970 was eleven years away from the next boom period of defense spending, which began in FY 1981. In contrast, a program that passed MS II in 1980 was born at the boundary of a period of growing funding; most of these programs would be expected to have completed EMD and entered LRIP before the Carter-Reagan defense boom ended with the FY 1986 budget. We might then expect the FY 1978–FY 1980 cohort to have a lower average PAUC growth associated with a Relatively Accommodating funding climate. In fact, we find the opposite. Similarly, in Case 2, we see the average PAUC growth for the FY 2000–FY 2002 cohort is the same as that for the FY 1987–FY 1989 cohort, even though starting in FY 2003, DoD entered a Relatively Accommodating funding climate. In Case 3 we find average PAUC growth higher for FY 1984–FY 1986 than for FY 1981–FY 1982 but still at a low value characteristic of periods of a Relatively Accommodating funding climate. The data then favor the position that the PAUC growth of programs tends to be characteristic of those of the periods in which they enter EMD and a complete Acquisition Program Baseline for the program is first established.

Table B-1. Comparison of First Three and Last Three Years of Three Funding Climates in Terms of Average PAUC Growth and Instances of PAUC Growth of at Least 50%

Case 1: Next Period of Relatively Accommodating Topline FY1979-FY1986

Passed MS II during	Average PAUC Growth	PAUC Growth ≥50%	No. of Observations
1970–1972	18%	2	9
1978–1980	24%	2	9

Case 2: Next Period of Relatively Accommodating Topline FY2002-FY2007

Passed MS II during	Average PAUC Growth	PAUC Growth ≥50%	No. of Observations
1987–1989	34%	2	11
2000–2002	45%	3	8

Case 3: Next Period of Relatively Constrained Topline FY1987-FY2001

Passed MS II during	Average PAUC Growth	PAUC Growth ≥50%	No. of Observations
1981–1983	4%	0	19
1984–1986	22%	3	16

Appendix C.
Average PAUC Growth by Acquisition Regime, Topline Condition, and Military Department/ Joint Program

Table C-1. MDAPs Average PAUC Growth by Service, Acquisition Regime, and Topline Condition

Service/ Acquisition Regime	Topline Relatively Constrained		Topline Relatively Accommodating	
	Period (FY)	PAUC Growth	Period (FY)	PAUC Growth
ARMY				
DSARC	1970–1980	36% (13)	1981–1982	N/A
DSARC post Carlucci	1987–1989	48% (6)	1983–1986	10% (6)
DAB	1990–1993	42% (5)	None	N/A
Acquisition Reform (AR)	1994–2000	82% (6)	None	N/A
DAB post AR	2001–2002	62% (1)	2003–2007	29% (2)
NAVY				
DSARC	1970–1980	25% (13)	1981–1982	-7% (1)
DSARC post Carlucci	1987–1989	17% (2)	1983–1986	10% (12)
DAB	1990–1993	31% (3)	None	N/A
Acquisition Reform (AR)	1994–2000	55% (9)	None	N/A
DAB post AR	2001–2002	9% (1)	2003–2007	8% (9)
USAF				
DSARC	1970–1980	38% (10)	1981–1982	8% (4)
DSARC post Carlucci	1987–1989	11% (1)	1983–1986	6% (7)
DAB	1990–1993	49% (2)	None	N/A
Acquisition Reform (AR)	1994–2000	77% (7)	None	N/A
DAB post AR	2001–2002	75% (3)	2003–2007	-7% (4)
JOINT				
DSARC	1970–1980	47% (6)	1981–1982	37% (1)
DSARC post Carlucci	1987–1989	20% (2)	1983–1986	38% (4)
DAB	1990–1993	-7% (1)	None	N/A
Acquisition Reform (AR)	1994–2000	50% (5)	None	N/A
DAB post AR	2001–2002	45% (1)	2003–2007	8% (4)

Note: Numbers in parentheses are the number of observations available.

Illustrations

Tables

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Abbreviations

ACAT	Acquisition Category
ANOVA	Analysis of Variance
AR	Acquisition Reform
CD	Compact Disc
CE	Current Estimate
CLC	Calibrated Learning Curve
DAB	Defense Acquisition Board
DAMIRS	Defense Acquisition Management Information Retrieval System
DLC	DAMIRS Learning Curve
DoD	Department of Defense
DoDI	Department of Defense Instruction
DSARC	Defense Systems Acquisition Review Council
EMD	Engineering and Manufacturing Development
FRP	Full Rate Production
FY	Fiscal Year
FYDP	Future Years Defense Plan
IDA	Institute for Defense Analyses
JDAM	Joint Direct Attack Munition
JSOW	Joint Standoff Weapon
LRIP	Low Rate Initial Production
MAIS	Major Automated Information System
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MS	Milestone
NQC	No Quantity Change
OSD	Office of the Secretary of Defense
PA&E	Program Analysis and Evaluation
PAUC	Program Acquisition Unit Cost
PM	Program Manager
PPBS	Planning, Programming, and Budgeting System

RDT&E	Research, Development, Test and Evaluation
SAR	Selected Acquisition Report
USAF	US Air Force
USD(AT&L)	Under Secretary of Defense (Acquisition, Technology and Logistics)
USMC	US Marine Corps
VCJCS	Vice Chairman, Joint Chiefs of Staff

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

This paper reports the results of research on whether changes in Department of Defense (DoD) acquisition policy and process have had a discernible effect on growth of Program Acquisition Unit Cost (PAUC) of major defense acquisition programs (MDAPs). Examination of PAUC growth data for 151 MDAPs that passed Milestone II or B during 1970–2007 does not reveal any substantial or consistent effect of changes in acquisition policy and process. Changes in budget climate, however, are found to have a large influence on PAUC growth. These findings have three implications for acquisition reform. First, the relevant context for understanding PAUC growth is the interface between the acquisition process and the program/budget process. Second, it seems unlikely that further changes in the acquisition process will have a major effect on PAUC growth. Third, the underlying cause of persistent high PAUC growth is not, as is commonly asserted, a deeply established culture of the DoD acquisition organizations and their professional employees. Relevant data are provided on the accompanying CD.

15. SUBJECT TERMS

Acquisition reform, cost growth, PAUC growth, acquisition culture, budget climate and cost growth, acquisition policy, acquisition process

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The computation of the Calibrated Learning Curve (CLC, DAMIRS Learning Curve (DLC), and Non Quantity Change (NQC) estimates is documented in Appendix Table A-4. The available documentation of the PA&E estimates is the briefing by John McCrillis on this CD. See Appendix A, the section entitled "PAUC Growth Estimates," beginning on page A-4, for further explanation of the PAUC growth estimates.

Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
5-Inch Guided Projectile	5-Inch Guided Projectile: Semi-Active Laser (SAL)	Navy	1978	1978	1981	.	
8-Inch Guided Projectile	8-Inch Guided Projectile: Unpowered Semi-Active Laser (U/P SAL)	Navy	1978	1978	1978	.	
A-10 Thunderbolt	A-10 Thunderbolt	Air Force	1973	1971	1980	0.29	PA&E
A-6E/F Intruder	A-6E/F Intruder	Navy	1984	1983	1988	.	
A-7D	A-7D	Air Force	1969	1969	1974	.	
A-7E	A-7E	Navy	1969	1969	1977	.	
ABL	Airborne Laser (ABL)	Air Force	1996	1996	1999	.	
ACM	AGM-129 Advanced Cruise Missile (ACM)	Air Force	1984	1989	1992	.	
ACS	Aerial Common Sensor (ACS)	Joint	2003	2004	2005	.	
ADDS EPLRS	Army Data Distribution System-Enhanced Position Location Reporting System (ADDS EPLRS)	Army	1985	1983	1994	0.26	PA&E
ADS (AN/WQR-3)	Advanced Deployable System (ADS (AN/WQR-3))	Navy	2005	2005	2007	.	
Aegis MK-7	Aegis MK-7	Navy	1970	1970	1979	0.26	PA&E
AEHF Satellite	Advanced Extremely High Frequency (AEHF) Satellite	Air Force	2001	1999	2012	1.38	CLC
AESA	Active Electronically Scanned Array (AESA)	Navy	2001	2001	2006	.	
AFATDS	Advanced Field Artillery Tactical Data Systems (AFATDS)	Army	1989	1990	1998	0.02	PA&E
AGM-114 Hellfire	AGM-114 Hellfire	Army	1976	1976	1993	0.70	PA&E
AGM-131A SRAM II	AGM-131A SRAM II (Short Range Missile)	Air Force	1987	1985	1991	.	
AGM-158 JASSM	AGM-158 Joint Air-to-Surface Standoff Missile (JASSM)	Air Force	1998	1996	2012	0.51	CLC
AGM-65D Maverick IR	AGM-65D Maverick IR	Joint	1979	1978	1992	0.32	PA&E
AGM-84A Harpoon	AGM-84A Harpoon	Navy	1973	1971	1991	0.56	PA&E
AGM-86B ALCM	AGM-86B Air Launched Cruise Missile (ALCM)	Air Force	1977	1977	1985	0.18	PA&E

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
AGM-88 HARM USAF/USN	AGM-88 High-speed Anti-Radiation Missile (HARM) (USAF/USN)	Joint	1978	1976	1993	0.50	PA&E
AGM-88E AARGM	AGM-88E Advanced Anti-Radiation Guided Missile (AGM-88E AARGM)	Joint	2003	2003	2012	0.18	CLC
AH-64 Apache	AH-64 Apache	Army	1977	1973	1991	0.64	PA&E
AH-64D Apache Airframe (Longbow Apache)	AH-64D Apache Airframe (Longbow Apache)	Army	1991	1990	2010	1.17	NQC
AH-64E New Build	AH-64E New Build	Army	2006	2010	2012	.	
AH-64E Remanufacture	AH-64E Remanufacture	Army	2006	2006	2012	0.56	CLC
AIM-54C Phoenix Missile	AIM-54C Phoenix Missile	Navy	1977	1969	1991	0.07	PA&E
AIM-7M Sparrow (USAF/USN)	AIM-7M Sparrow (USAF/USN)	Joint	1980	1972	1986	0.21	PA&E
AIM-9L Sidewinder	AIM-9L Sidewinder (USAF/USN)	Joint	1973			0.62	PA&E
AIM-9M Sidewinder	AIM-9M Sidewinder (USN/USAF)	Joint	1980	1973	1983	0.14	PA&E
AIM-9X Sidewinder	AIM-9X Sidewinder	Navy	1997	1994	2011	0.08	CLC
ALQ-165 ASPJ (Jammer)	ALQ-165 Airborne Self-Protection Jammer (ASPJ)	Navy	1983	1983	1992	.	
ALQ-212(V) ATIRCM/CMWS	ALQ-212(V) Advanced Threat Infrared Countermeasures/Common Missile Warning System (ATIRCM/CMWS)	Army	1995	1995	2010	.	
AMRAAM USN/USAF	Advanced Medium-Range Air-to-Air Missile (AMRAAM) (USAF/USN)	Joint	1982	1982	2011	0.37	PA&E
AN/BQQ-5	AN/BQQ-5	Navy	1972	1972	1973	.	
AN/BSY-1	AN/BSY-1	Navy	1983	1983	1992	.	
AN/SQQ-89	AN/SQQ-89	Navy	1986	1986	1996	.	
AOE 6	AOE 6	Navy	1987	1988	1996	.	
Aquila RPV	Aquila, Remotely Piloted Vehicle (RPV)	Army	1983	1983	1987	.	
ARC-210 SINCGARS Radio	ARC-210 Single-channel Ground and Airborne Radio System (SINCGARS)	Army	1983	1983	1999	-0.18	PA&E
ARH	Armed Reconnaissance Helicopter (ARH)	Army	2005	2005	2008	.	
ASAT	Anti-Satellite (ASAT)	Air Force	1983	1983	1987	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
ASDS	Advanced SEAL Delivery System (ASDS)	Navy	1994	2003	2005	.	
ATACMS Blk I (APAM)/Blk II/IIA	Army Tactical Missile System-Anti-Personnel, Anti-Materiel (ATACMS-APAM) Blk I/Blk II/IIA	Army	1986	1984	1999	0.13	PA&E
ATACMS P3I (BAT)	Army Tactical Missile System-Brilliant Anti-armor Technology (ATACMS P3I BAT)	Army	1991	1991	2002	.	
ATARS	Advanced Tactical Airborne Reconnaissance System (ATARS)	Joint	1987	1987	1993	.	
ATCCS-ASAS BLK II/III*	Army Tactical Command and Control System-All Source Analysis System (ATCCS-ASAS) BLK II/III	Army	1993	1984	1998	0.49	PA&E
ATCCS-CSSCS	Army Tactical Command and Control System-Combat Service Support Control System (ATCCS-CSSCS)	Army	1991	1991	1998	0.04	PA&E
ATCCS-FAAD C2I	Army Tactical Command and Control System-Forward Area Air Defense Command Control and Intelligence System (ATCCS FAAD C2I)	Army	1986	1984	1998	0.28	PA&E
ATCCS-MCS	Army Tactical Command and Control System-Maneuver Control System (ATCCS-MCS)	Army	1980	1991	2004	-0.34	PA&E
AV-8A	AV-8A Harrier	Navy	1971	1971	1973	.	
AV-8B Harrier	AV-8B Harrier II	Navy	1981	1981	1992	-0.07	PA&E
AV-8B Harrier Remanufacture	AV-8B Harrier Remanufacture	Navy	1994	1994	2002	0.02	PA&E
AWACS Blk 40/45 Upgrade	Airborne Warning and Control System Block 40/45 Upgrade (AWACS Blk 40/45 Upgrade)	Air Force	2003	2012	2012	.	
B-1	B-1 Lancer	Air Force	1969	1969	1978	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
B-1 CMUP-DSUP	B-1 Conventional Mission Upgrade Program-Defensive System Upgrade Program (CMUP-DSUP)	Air Force	1997	1997	1997	.	
B-1B CMUP	B-1B Conventional Mission Upgrade Program (CMUP)	Air Force	1995	1998	2004	-0.12	PA&E
B-1B Lancer	B-1B Lancer	Air Force	1982	1981	1992	0.03	PA&E
B-2 EHF Inc. 1	B-2 Extremely High Frequency SATCOM and Computer Increment 1 (B-2 EHF Inc 1)	Air Force	2007	2007	2012	-0.20	CLC
B-2 RMP	B-2 Radar Modernization Program (RMP)	Air Force	2004	2004	2011	-0.03	CLC
B-2A	B-2A	Air Force	.	1996	1996	.	
B-52 OAS/CMI MODS	B-52 OAS/CMI MODS	Air Force	1982	1982	1995	.	
Battleship React	Battleship React	Navy	1982	1982	1988	.	
BGM-109G Tomahawk GLCM	BGM-109G Tomahawk Ground Launched Cruise Missile (GLCM)	Air Force	1977	1977	1988	0.81	PA&E
C-130 AMP	C-130 Avionics Modernization Program (AMP)	Air Force	2001	2001	2011	.	
C-130H	C-130H	Air Force	1974	1992	1994	.	
C-130J Hercules	C-130J Hercules	Air Force	1996	1996	2012	0.84	CLC
C-17A Globemaster	C-17A Globemaster	Air Force	1985	1983	2010	0.57	PA&E
C-27J	C-27J Spartan	Air Force	2007	2008	2010	.	
C-5 AMP	C-5 Avionics Modernization Program (AMP)	Air Force	1999	2006	2010	.	
C-5 RERP	C-5 Reliability Enhancement and Re-engining Program (RERP)	Air Force	2002	2001	2012	0.32	CLC
C-5A	C-5A Galaxy	Air Force	1969	1969	1972	.	
C-5B Galaxy	C-5B Galaxy	Air Force	1983	1982	1988	-0.20	PA&E
CAPTOR (MK 60 MINE)	MK 60 Encapsulated Torpedo (CAPTOR) Mine	Navy	1975	1975	1983	.	
CBU-97B SFW	CBU-97B SFW (Sensor Fuzed Weapon)	Air Force	1986	1984	1998	0.05	PA&E

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
CEC	Cooperative Engagement Capability (CEC)	Navy	1995	1995	2012	0.62	DLC
CG 47 Aegis Cruiser	CG 47 Aegis Cruiser	Navy	1978	1978	1992	-0.07	PA&E
CGN-38	CGN-38 Virginia	Navy	1969	1969	1979	.	
CH-47 Chinook	CH-47D Chinook	Army	1978	1978	1992	0.27	PA&E
CH-47F	CH-47F (Improved Cargo Helicopter)	Army	1998	1998	2012	1.73	CLC
CH-53 Super Stallion & MH-53 Sea Dragon	CH-53 Super Stallion & MH-53 Sea Dragon	Navy	1975	1973	1995	0.52	PA&E
CH-53K	CH-53K Heavy Lift Replacement Helicopter	Navy	2006	2005	2012	0.21	CLC
Cheyenne	AH-56 Cheyenne	Army	1969	1969	1971	.	
Cheyenne Mountain Upgrade	Cheyenne Mountain Upgrade (CMU)	Air Force	1989	1989	1996	0.11	NQC
CIS (MK XV IFF)	CIS (MK XV IFF)	Air Force	1984	1984	1990	.	
Cobra Judy Replacement	Cobra Judy Replacement	Navy	2003	2003	2011	0.12	NQC
Condor	Condor	Navy	1969	1969	1976	.	
Crusader	Crusader	Army	1994	1994	2001	.	
CSRL (Rotary Launcher)	Common Strategic Rotary Launcher (CSRL)	Air Force	1985	1985	1988	-0.22	PA&E
CVN 21/CVN 78	CVN 21/CVN 78	Navy	2004	2000	2012	-0.12	NQC
CVN 68 Class (USS Nimitz)	CVN 68 Class (USS Nimitz)	Navy	1970	1970	2009	0.07	PA&E
DD 963	DD 963	Navy	1969	1969	1978	.	
DD(X) / DDG-1000	DD(X)/DDG-1000	Navy	2005	1998	2012	.	
DDG-51 Burke	DDG-51 Burke	Navy	1983	1982	2011	0.16	PA&E
DE 1052	DE 1052/FF-1052 Knox Class Frigate	Navy	1971	1971	1971	.	
D-HLH	XCH-62 Heavy Lift Helicopter (D-HLH)	Joint	1971	1971	1974	.	
DIVAD (SGT York)	Sergeant York DIVAD (Division Air Defense)	Army	1978	1978	1984	.	
DMSP (Metorological Satellite)	Defense Meteorological Satellite Program (DMSP)	Air Force	1983	1983	1998	0.17	PA&E
DSCS II	Defense Satellite Communications System (DSCS) II	Joint	1971	1971	1971	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
DSCS-III	Defense Satellite Communications System (DSCS) III	Joint	1977	1977	1990	1.00	PA&E
DSP	Defense Support Program (DSP)	Air Force	1983	1983	1996	.	
E-2C	E-2C Hawkeye	Navy	1971	1971	1991	.	
E-2C Reproduction	E-2C Reproduction	Navy	1994	1994	2006	0.26	CLC
E-2D AHE	E-2D Advanced Hawkeye (AHE)	Navy	2003	2003	2011	0.28	NQC
E-3 Sentry AWACS RSIP	E-3A Sentry AWACS Radar System Improvement Program (RSIP)	Joint	1989	1989	2003	0.48	PA&E
E-3A Sentry AWACS	E-3A Sentry Airborne Warning and Control System (AWACS)	Air Force	1970	1970	1983	0.31	PA&E
E-4 AABNCP NEACP	E-4 Advanced Airborne Command Post-National Emergency Airborne Command Post (AABNCP-NEACP)	Air Force	1973	1973	1981	0.26	PA&E
E-6A TACAMO	E-6A Mercury, Take Charge and Move Out (TACAMO)	Navy	1983	1983	1991	0.00	PA&E
EA-18G	EA-18G Growler	Navy	2004	2003	2011	0.07	CLC
EA-6B ICAP III	EA-6B Improved Capability (ICAP) III (EA-6B ICAP III)	Navy	1998	2008	2009	.	
EA-6B Prowler ADVCAP	EA-6B Prowler, Advanced Capability (ADVCAP)	Navy	1983	1971	1993	-0.05	PA&E
EELV (Atlas V & Delta IV)	Evolved Expendable Launch Vehicle (EELV) (Atlas V & Delta IV)	Air Force	1998	1996	2012	0.80	CLC
EF-111A TJS	EF-111A Tactical Jamming System (TJS)	Air Force	1976	1976	1983	0.42	PA&E
EFV (Formerly AAAV)	Expeditionary Fighting Vehicle (EFV/AAAV)	Navy	2001	1992	2010	.	
EMSP	AN/UYS-2(V) Enhanced Modular Signal Processor (EMSP)	Navy	1983	1991	1992	.	
ERM	Extended Range Munition (ERM)	Navy	1996	2006	2008	.	
Excalibur	Excalibur	Army	1997	2002	2011	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
F/A-18 E/F Super Hornet	F/A-18 E/F Super Hornet	Navy	1992	1991	2012	0.09	DLC
F/A-18 Hornet	F/A-18 Hornet	Navy	1976	1976	1994	0.48	PA&E
F-14A	F-14A	Navy	1969	1969	1986	.	
F-14D Tomcat	F-14D Tomcat	Navy	1986	1986	1993	-0.06	PA&E
F-15 Eagle	F-15 Eagle	Air Force	1970	1969	1990	0.50	PA&E
F-16 Falcon	F-16 Falcon	Air Force	1975	1975	1994	0.15	PA&E
F-22 ATF	F-22 Advanced Tactical Fighter (ATF)	Air Force	1991	1983	2010	0.55	DLC
F-35 JSF	F-35 Joint Srike Fighter (JSF)	Joint	2002	1996	2011	0.45	NQC
F-5E Tiger	F-5E Tiger	Air Force	1971	1971	1993	0.01	PA&E
FAADS LOS-F-H ADATS	Forward Area Air Defense System, Line-of-Sight-Forward, Heavy, Air Defense Anti-Tank System (FAADS LOS-F-H ADATS)	Army	1987	1986	1991	.	
FAADS LOS-R Avenger	Forward Area Air Defense System Line-of-Sight Rear (FAADS LOS-R) Avenger	Army	1987	1986	1994	0.23	PA&E
FAADS NLOS	FAADS NLOS	Army	1987	1986	1991	.	
FAB-T	Family of Beyond Line-of-Sight - Terminals (FAB-T)	Joint	2007	2006	2012	0.20	CLC
FB-111A	FB-111A Aardvark	Air Force	1969	1969	1970	.	
FBCB2	Force XXI Battle Command Brigade and Below (FBCB2)	Army	1998	1999	2010	-0.05	DLC
FCS	Future Combat Systems (FCS)	Army	2003	2003	2004	.	
FDS	Fixed Distributed System (FDS)	Navy	1989	1986	1994	.	
FFG-7	FFG-7 Oliver Hazard Perry Class	Navy	1973	1973	1986	0.30	PA&E
FGM-148A Javelin AAWS-M	FGM-148A Javelin Advanced Anti-Tank Weapon System—Medium (AAWS-M)	Army	1989	1989	2007	1.34	DLC
FIM-92 Stinger Missile	FIM-92 Stinger Missile	Army	1973	1973	1988	1.10	PA&E
FMTV	Family of Medium Tactical Vehicles (FMTV)	Army	1987	1988	2011	1.00	PA&E

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
Follow-on Early Warning System (FEWS)	Follow-on Early Warning System (FEWS)	Air Force	1992	1992	1992	.	
FPS-118 OTH-B (Radar)	FPS-118 Over-The-Horizon-Backscatter (OTH-B) Radar	Air Force	1983	1983	1990	0.08	PA&E
G/ATOR	Ground/Air Task Oriented Radar (G/ATOR)	Navy	2005	2012	2012	.	
GBS	Global Broadcast Service (GBS)	Air Force	1998	1997	2012	0.33	DLC
Global Hawk	RQ-4A/B Global Hawk	Air Force	2001	2001	2011	.	
GMLRS	Guided Multiple Launch Rocket System (GMLRS)	Army	1998	1997	2012	2.49	CLC
H-1 Upgrades	H-1 Upgrades	Navy	1996	1996	2012	1.97	DLC
Hawk Improved	Hawk Improved	Army	1971	1971	1977	.	
HFAJ	High Frequency Anti-Jam (HFAJ)	Navy	1987	1987	1987	.	
HHD-60	HH-60D Night Hawk	Air Force	1983	1983	1983	.	
HIMARS	High Mobility Artillery Rocket System (HIMARS)	Army	2000	2002	2012	-0.06	DLC
IDECM	Integrated Defensive Electronic Countermeasures (IDECM)	Navy	1996	2008	2012	.	
I-S/A AMPE	Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)	Joint	1984	1984	1987	.	
IUS	Inertial Upper Stage (IUS)	Air Force	1982	1982	1993	0.31	PA&E
JDAM	Joint Direct Attack Munition (JDAM)	Joint	1995	1992	2012	-0.10	CLC
JLENS	Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	Army	2005	2005	2012	.	
Joint Common Missile	Joint Common Missile (JCM)	Joint	2002	2004	2004	.	
Joint MRAP	Joint Mine Resistant Ambush Protected (Joint MRAP)	Joint	2007	2007	2010	-0.07	CLC
JSIMS	Joint Simulation System (JSIMS)	Joint	1994	2001	2002	.	
JSOW	Joint Standoff Weapon (JSOW)	Joint	1992	1990	2012	-0.07	DLC

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
JSTARS GSM	Joint Surveillance Target Attack Radar System-Ground Station Module (JSTARS GSM)	Joint	1985	1991	2001	0.16	PA&E
JSTARS USAF	Joint Surveillance Target Attack Radar System (JSTARS) USAF	Joint	1985	1984	2003	1.23	PA&E
JTIDS (USAF/USA/USN)	Joint Tactical Information Distribution System (JTIDS) (USAF/USA/USN)	Joint	1982	1982	1995	.	
JTRS CLUSTER 1 (JTRS GMR)	Joint Tactical Radio System (JTRS) Cluster 1 (JTRS GMR)	Joint	2002	2002	2011	.	
JTRS CLUSTER 5 (JTRS HMS)	Joint Tactical Radio System (JTRS) Cluster 5 (JTRS HMS)	Joint	2004	2004	2011	0.00	CLC
JTRS Waveform	Joint Tactical Radio System (JTRS) Waveform	Joint	2002	2002	2004	.	
JTUAV Short Range Hunter	Joint Tactical Unmanned Aerial Vehicle (JTUAV) Short Range Hunter	Joint	1995	1990	1995	.	
KC-10A	KC-10A Extender	Air Force	1983	1983	1986	.	
KC-130J	KC-130J Transport Aircraft (KC-130J)	Navy	1995	2010	2012	.	
KC-135R Stratotanker	KC-135R Stratotanker	Air Force	1982	1982	1994	-0.16	PA&E
Kiowa Warrior	Kiowa Warrior	Army	1981	1981	1994	.	
LAIRCM	Large Aircraft Infrared Countermeasures (LAIRCM)	Air Force	2001	2007	2011	.	
Lance	Lance	Army	1969	1969	1977	.	
Land Warrior	Land Warrior	Army	1994	2002	2006	.	
LANTIRN (Low Alt Nav & Targeting Sys)	Low Altitude Navigation & Targeting System (LANTIRN)	Air Force	1982	1982	1993	0.16	PA&E
LAV (USA/USN)	Light Armoured Vehicle (LAV) (USA/USN)	Joint	1982	1982	1983	.	
LCAC	Landing Craft Air Cushion (LCAC)	Navy	1983	1983	1994	0.09	PA&E
LCS	Littoral Combat Ship (LCS)	Navy	2004	2004	2011	.	
LGM-118A Peacekeeper	LGM-118A Peacekeeper	Air Force	1983	1983	1992	-0.04	PA&E
LGM-118A Peacekeeper Rail Garrison	LGM-118A Peacekeeper Rail Garrison	Air Force	1988	1986	1991	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
LGM-30 Minuteman III GRP	LGM-30 Minuteman III Guidance Replacement Program (GRP)	Air Force	1993	1993	2008	0.43	NQC
LGM-30 Minuteman III PRP	LGM-30 Minuteman III Propulsion Replacement Program (PRP)	Air Force	1994	1996	2009	0.06	NQC
LHA	Landing Helicopter Assault (LHA)	Navy	1969	1969	1978	.	
LHD 1 Amphibious Assault Ship	LHD 1 Amphibious Assault Ship	Navy	1983	1976	2005	-0.13	PA&E
LLLBGK	Low Level Laser Bomb Guidance Kit (LLLBGK)	Air Force	1983	1983	1984	.	
Longbow Hellfire	AGM-114K Hellfire Longbow	Army	1991	1990	2004	0.12	PA&E
LPD 17 Amphibious Transport Dock Ship	LPD 17 Amphibious Transport Dock Ship	Navy	1996	1993	2012	0.72	DLC
LSD 41 Whidbey Island	LSD 41 Whidbey Island	Navy	1983	1987	1991	-0.01	PA&E
LSD 41 Whidbey Island Cargo Variant	LSD 41 Whidbey Island Cargo Variant	Navy	1988	1984	1990	0.05	PA&E
LUH	Light Utility Helicopter (LUH)	Army	2006	2006	2012	0.01	CLC
M1 Abrams Tank	M1 Abrams Tank	Army	1976	1973	1991	0.58	PA&E
M198 155MM Howitzer	M198 155MM Howitzer	Army	1975	1975	1980	0.13	PA&E
M1A2 Abrams Tank Upgrade	M1A2 Abrams Tank Upgrade	Army	1989	1992	2003	0.32	PA&E
M2/M3 Bradley FVS	M2/M3 Bradley Fighting Vehicle Systems (BFVS)	Army	1978	1973	1992	1.13	PA&E
M2/M3 Bradley FVS Upgrade	M2/M3 Bradley Fighting Vehicle Systems (FVS) Upgrade	Army	1994	1993	2009	0.54	CLC
M26 MLRS	M26 Multiple Launch Rocket System (MLRS)	Army	1978	1978	1995	0.02	PA&E
M47 Dragon Guided Missile	M47 Dragon Guided Missile	Army	1971	1971	1977	-0.12	PA&E
M551 Sheridan	M551 Sheridan, Armored Reconnaissance/Airborne Assault Vehicle (AR/AAV)	Army	1970	1970	1970	.	
M6042 Tank	M6042 Tank	Army	1969	1969	1973	.	
M712 Copperhead	M712 Copperhead, Cannon Launched Guided Projectile (CLGP)	Army	1975	1975	1988	.	
Maverick (Laser)	Maverick (Laser)	Joint	1969	1969	1978	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
Maverick (TV)	Maverick (TV)	Air Force	1973	1973	1973	.	
MCM 1	MCM 1 Avenger	Navy	1981	1988	1993	.	
MEADS	Medium Extended Air Defense System (MEADS)	Joint	2004	2004	2011	.	
MH-60R Strikehawk	MH-60R Strikehawk	Navy	1993	1994	2012	0.80	DLC
MH-60S (Formerly CH-60S)	MH-60S (Formerly CH-60S)	Navy	1998	1998	2012	0.70	DLC
MHC-51	MHC 51 (OSPREY Class) Coastal Minehunter Ship	Navy	1986	1997	1998	.	
MIDS LVT	Multifunctional Information Distribution Systems-Low Volume Terminal (MIDS LVT)	Joint	1994	1992	2012	0.68	DLC
MILSTAR	Military Strategic and Tactical Relay (MILSTAR)	Air Force	1983	1992	1999	.	
MIM-104 Patriot Guided Missile System	MIM-104 Patriot Guided Missile System	Army	1976	1969	1991	0.05	PA&E
Minuteman II	Minuteman II	Air Force	1969	1969	1972	.	
Minuteman III	Minuteman III	Air Force	1969	1969	1977	.	
MK 48 ADCAP	MK 48 ADCAP	Navy	1982	1985	1994	.	
MK 48 Torpedo	MK 48 Torpedo	Navy	1969	1969	1978	.	
MK 50 Torpedo	MK 50 Torpedo	Navy	1983	1983	1994	.	
MK-15 Phalanx CIWS	MK-15 Phalanx Close-In Weapon System (CIWS)	Navy	1973	1973	1993	.	
MLRS-TGW	Multiple Launch Rocket System-Terminal Guidance Warhead (MLRS-TGW)	Army	1984	1984	1991	.	
MLV III	Medium Launch Vehicle (MLV) III	Air Force	1990	1992		.	
MP RTIP	Multi-Platform Radar Technology Insertion Program (MP RTIP)	Air Force	2003	2003	2011	.	
MQ-1C Gray Eagle	MQ-1C Gray Eagle	Army	2005	2009	2012	.	
MQ-9 Reaper	MQ-9 Reaper Unmanned Aircraft System	Air Force	2004	2009	2012	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
MSE	Mobile Subscriber Equipment (MSE)	Army	1986	1985	1992	0.01	PA&E
MUOS	Mobile User Objective System (MUOS)	Navy	2004	2004	2011	0.05	NQC
NAS	National Airspace System (NAS)	Joint	1995	1993	2012	0.21	CLC
NATO AAWS	NATO Anti-Air Warfare System (AAWS)	Joint	1988	1988	1990	.	
NATO PHM Pegasus Class	NATO PHM Pegasus Class	Joint	1973	1973	1981	.	
Navstar GPS	Navstar GPS	Air Force	1974	1980	2011	0.85	PA&E
Navy Area TBMD	Navy Area Theater Ballistic Missile Defense (TBMD)	Joint	1997	1997	2001	.	
NESP	Navy EHF SATCOM Program (NESP)	Navy	1982	1992	2004	.	
NMT	Navy Multiband Terminal Satellite (NMT)	Joint	2004	2006	2012	.	
NPOESS	National Polar-orbiting Operational Environmental Satellite System (NPOESS)	Joint	2002	1997	2011	.	
NTW	Navy Theater Wide (NTW)	Navy	1975	1975	1999	.	
P-3C	P-3C	Navy	1969	1969	1989	.	
P-7A (LRAACA)	P-7A Long Range Air ASW-Capable Aircraft (LRAACA)	Navy	1989	1988	1989	.	
P-8A Poseidon	P-8A Poseidon (formerly the Multimission Maritime Aircraft or MMA)	Navy	2004	2004	2004	0.00	CLC
PAC-3	Patriot Advanced Capability-3 (PAC-3)	Joint	1994	1994	2012	1.30	NQC
Pershing II	Pershing II	Army	1979	1979	1986	.	
PLS FHTV	Palletized Load System-Family of Heavy Tactical Vehicles (PLS FHTV)	Army	1988	1988	1995	-0.01	PA&E
PLSS	Precision Location Strike System (PLSS)	Air Force	1978	1978	1986	.	
Poseidon	Poseidon	Navy	1969	1969	1974	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
RAH-66 Comanche	RAH-66 Comanche	Army	2000	1985	2003	.	
RGM-109 Tomahawk BIP	RGM-109 Tomahawk Baseline Improvement Program (TBIP)	Navy	1977	1977	2004	0.09	PA&E
RIM-67 Standard Missile II	RIM-67 Standard Missile II	Navy	1983	1983	2004	0.19	PA&E
RMS	Remote Minehunting System (RMS)	Navy	1999	2006	2012	.	
Roland	Roland	Army	1975	1975	1981	.	
ROTHR	AN/TPS-71 Relocatable Over-the-Horizon Radar (ROTHR)	Navy	1984	1990	1990	.	
S-3A	S-3A	Navy	1969	1969	1976	.	
SADARM Rocket	Sense and Destroy ARMor (SADARM) Rocket	Army	1988	1987	2001	.	
Safeguard	Safeguard Ballistic Missile Defense	Army	1969	1969	1973	.	
SBIRS (Space Based IR Sensor) High	Space Based IR Sensor (SBIRS) High	Air Force	1997	1995	2012	3.00	NQC
SBSS Block 10	Space Based Space Surveillance (SBSS) Block 10	Air Force	2003	2007	2010	0.11	NQC
SCAMP (BLOCK II)	Single Channel Anti-Jam Man-Portable (SCAMP) BLOCK II	Joint	1992	1992	1994	.	
SCOUT	XM800 Armored Reconnaissance vehicle (ARSV) (a.k.a. SCOUT)	Army	1973	1973	1974	.	
SDB	Small Diameter Bomb (SDB)	Air Force	2004	2003	2007	-0.17	NQC
Sea Lance	UUM-125 Sea Lance	Navy	1983	1983	1988	.	
SH-60B LAMPS Mk III	SH-60B Light Airborne Multipurpose System (LAMPS) MK III	Navy	1977	1976	1993	0.33	PA&E
SH-60F CV Helo	SH-60F CV Helo	Navy	1985	1985	1993	0.15	PA&E
Shillelagh Missile	Shillelagh Missile	Army	1969	1969	1970	.	
SLAT (AQM-127A)	AQM-127A Supersonic Low-Altitude Target (SLAT)	Navy	1984	1988	1991	.	
SM-6	SM-6	Navy	2004	2004	2011	0.08	CLC
Small ICBM	MGM-134 Midgetman (Small ICBM)	Air Force	1986	1985	1991	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
SMART-T	Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T)	Army	1992	1992	2002	0.28	PA&E
Sparrow (AIM-7E)	AIM-7E Sparrow (AF)	Air Force	1969	1969	1970	.	
Sparrow (AIM-7F)	AIM-7F Sparrow (USAF/USN)	Joint	1970	1970	1978	.	
SQR-19 TACTAS	SQR-19 Tactical Towed Array SONAR (TACTAS)	Navy	1977	1977	1985	0.61	PA&E
SRAM	Short Range Attack Missile (SRAM)	Air Force	1969	1969	1973	.	
SSDS	Ship Self Defense System (SSDS)	Navy	1995	2004	2007	.	
SSGN	SSGN Ohio Class Conversion	Navy	2003	2002	2007	0.00	NQC
SSN 21 / AN/BSY-2	High Speed Nuclear Attack Submarine & Combat System (SSN 21 CLASS/BSY-2)	Navy	1988	1986	1999	.	
SSN 637	SSN 637	Navy	1971	1971	1971	.	
SSN 688 Los Angeles	SSN 688 Los Angeles	Navy	1971	1969	1993	0.19	PA&E
SSN 774 Virginia Class New Attack Sub	SSN 774 Virginia Class New Attack Sub	Navy	1995	1994	2012	0.33	NQC
Stinger RMP	Stinger RMP	Army	1983	1989	1994	.	
Stingray	Stingray	Army	1991	1991	1991	.	
Stryker	Stryker	Army	2000	1999	2012	0.25	CLC
SURTASS	Surveillance Towed Array Sensor System (SURTASS)	Navy	1975	1975	1980	.	
SYQ-23 JSIPS	SYQ-23 Joint Service Imagery Processing System (JSIPS)	Joint	1987	1992	1998	-0.08	PA&E
T-45 Goshawk	T-45 Goshawk Training System	Navy	1984	1983	2007	0.70	PA&E
T-46A Eaglet	T-46A Eaglet Trainer	Air Force	1983	1983	1986	.	
T-6A JPATS	T-6A Joint Primary Aircraft Training System (JPATS)	Joint	1995	1992	2012	0.40	CLC
TACFIRE	Tactical Fire Direction System (TACFIRE)	Army	1971	1971	1981	.	
Tacit Rainbow	Tacit Rainbow	Joint	.	1987	1990	.	
T-AGOS	T-AGOS	Navy	1977	1991	1994	.	
T-AKE	T-AKE	Navy	2001	2001	2011	0.09	CLC

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
T-AKR 295 Strategic Sealift	T-AKR 295 Strategic Sealift	Navy	1993	1992	2001	0.04	PA&E
T-AO 187 Oiler	T-AO 187 Oiler	Navy	1984	1984	1994	-0.03	PA&E
THAAD	Terminal High Altitude Area Defense (THAAD)	Joint	2000	1992	2000	.	
Titan IV ELV	Titan IV Expendable Launch Vehicle (ELV)	Air Force	1985	1985	2001	.	
TOW	TOW	Army	1971	1971	1976	.	
TOW 2	TOW 2	Army	1984	1983	1993	0.13	PA&E
Trident II Missile (UGM-133A)	Trident II Missile (UGM-133A)	Navy	1983	1981	2011	0.15	PA&E
Trident Submarine	Trident Submarine	Navy	1971	1971	1983	-0.14	PA&E
TRI-TAC	Tri-Service Tactical (TRI-TAC)	Air Force	1983	1983	1989	.	
TRN-45 MMLS Ground Components	TRN-45 MMLS Ground Components	Joint	1985	1984	1988	-0.04	PA&E
TSAT	Transformational Satellite Communications System (TSAT)	Air Force	2003	2004	2004	.	
TTC-39 Nodal Communication Switch	TTC-39 Nodal Communication Switch	Army	1974	1974	1984	-0.01	PA&E
TWS	AN/PAS-13(V) Thermal Weapon Sight (TWS)	Army	1990	2011	2012	.	
UGM-109E Tactical Tomahawk	UGM-109E Tactical Tomahawk	Navy	1998	1998	2012	0.27	DLC
UH-60A Black Hawk	UH-60A Black Hawk	Army	1972	1971	1999	0.53	PA&E
UH-60M Black Hawk Upgrade	UH-60M Black Hawk Upgrade	Army	2001	2001	2012	0.62	CLC
UHF Follow-On Comm Satellite Sys	UHF Follow-On Communication Satellite System	Navy	1988	1988	1997	0.30	PA&E
USQ-84(V) SOTAS	USQ-84(V) Stand-Off Target Acquisition System (SOTAS)	Army	1978	1978	1981	.	
V-22 Osprey	V-22 Osprey	Joint	1986	1984	2011	0.15	PA&E
VAST	Virtual At Sea Training System (VAST)	Navy	1971	1971	1974	.	
VH-71	VH-71 Presidential Helicopter Replacement	Navy	2005	2005	2007	.	
VTUAV	MQ-8 Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle Fire Scout (VTUAV)	Navy	2000	2006	2012	.	

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Short Name	Full Name	Service	MS2/1st SAR	First SAR	Last SAR	PAUC Growth	Source
WAM (WWMCCS/WIS)	WAM World Wide Military Command and Control System Information System (WWMCCS-WIS)	Joint	1983	1983	1991	.	
WGS	Wideband Gapfiller Satellite (WGS)	Air Force	2001	2001	2012	0.55	CLC
WIN-T	Warfighter Information Network - Tactical (WIN-T)	Army	2002	2003	2006	.	
XM803 Tank	XM803 Tank	Army	1969	1969	1970	.	

	Short	Full Name	Notes	Service	SAR Record
1	AMRAAM	Advanced Medium-Range Air-to-Air Missile (AMRAAM)	Joint--duplicate of AMRAAM USAF (185)	Navy	1982-1985
2	LAV	Light Armoured Vehicle	Joint--duplicate of LAV USN (769)	DoD-Army	1982-1983
3	AIM-7F Sparrow	AIM-7F Sparrow	Joint--duplicate of AIM-7F Sparrow USAF (408)	Navy	1969-1972, 1974-1979
4	AIM-7M Sparrow	AIM-7M Sparrow	Joint--duplicate of AIM-7M Sparrow USAF (165)	Navy	1979-1988
5	Tacit Rainbow (JGL)	Tacit Rainbow (JGL)	Joint--duplicate of Tacit Rainbow USAF (754)	Army	1990
6	AGM-88 HARM	AGM-88 High-speed Anti-Radiation Missile (HARM)	Joint--duplicate of HARM USAF (132)	Navy	1978-1993
7	JTIDS Army	Joint Tactical Information Distribution System (JTIDS)	Joint--duplicate of JTIDS USAF (172)	Army	1982-1985
8	JTIDS Navy	Joint Tactical Information Distribution System (JTIDS)	Sub-programof JTIDS	Navy	1982-1985
9	AIM-9M Sidewinder	AIM-9M Sidewinder	Joint--duplicate of AIM-9M Sidewinder USN (162)	Air Force	1973-1983
10	AN/BSY-2	AN/BSY-2	Merged with SSN 21/AN/BSY-2 (258)	Navy	
11	CVN-68	CVN-68	Duplicate	Navy	1969
12	EJS	Enhanced JTIDS System (EJS)	Program cancelled before MS II	Air Force	1983-1985
13	B-1 CMUP-Computer Upgrade	B-1 CMUP-Computer Upgrade	Merger. In 1999, B-1 CMUP-JDAM (PNO 598) and B-1 CMUP-Computer Upgrade (PNO 262) were combined into B-1B CMUP (Conventional Mission Upgrade Prgm) (PNO 288).	Air Force	1996-1997
14	B-1 CMUP-JDAM	B-1 CMUP-JDAM	See preceding entry	Air Force	1995-1997
15	GCSS-Army (Original)	Global Combat Support System Army (GCSS Army)	MAIS program	Army	2001
16	MPS	Mission Planning System (MPS)	MAIS program	Air Force	2004
17	AN/SQY-1	AN/SQY-1	Previously called the AN/SQQ-89 I. Did not have MS II before its cancellation.	Navy	1990-1991
18	AFX	AFX	Joint USN/USAF program; cancelled well before MS II.	Navy	1992
19	F-14 Block I Strike Upgrade	F-14 Block I Strike Upgrade	Program descope left the program below the ACAT I threshold before MS II.	Navy	1993-1994
20	MLR	Medium Lift Replacement (MLR)	Never reached MS II or even MS I.	Navy	1992-1994
21	ATM	Anti-Tactical Missile (ATM), Joint Tactical Missile Defense (JTMD), Tactical Missile Defense (TMD)	This was a variantofan eventual Ballistic Missile Defense Agency program. It did not have a MS II review.	Army	1987-1988
22	ASM	Armored Systems Modernization (ASM)	At time of cancellation, the program was pre-MS II but post-MS I.	Army	1990-1991

	Short	Full Name	Notes	Service	SAR Record
23	AAAM	Advanced Air-to-Air Missile (AAAM)	Program started before first the SAR, which announced its termination pre-MS II.	Navy	1991
24	F-111A/D/E/F	F-111A/D/E/F	UASF only continuation of the initial joint UASF/USN F-111 program.	Air Force	1969-1974
25	NMD	National Missile Defense (NMD)	Collection of MDAPs	DoD	1997-1999
25	BMDS	Ballistic Missile Defense System (BMDS)	Collection of MDAPs	DoD	2001-2004
27	GPALS (SDS)	Global Protection Against Limited Strikes (GPALS (SDS))	Collection of MDAPs	MDA	1990-1994
28	Chem Demil (Legacy)	Chemical Demilitarization (Chem Demil) (Legacy)	Collection of MDAPs	Army	1994-1997
29	Patriot P3I	Patriot P3I	Collection of MDAPs	Army	1993-1994
30	Chem Demil - ACWA	Chemical Demilitarization-Assembled Chemical Weapons Alternatives (Chem Demil - ACWA)	Program required by treaty and by the Congress.	Army	2004
31	Chem Demil - CMA	Chemical Demilitarization-Chemical Materials Activity (Chem Demil - CMA)	Program required by treaty and by the Congress.	Army	1998-2004
32	Chem Demil - CMA NEWPORT	Chemical Demilitarization-Chemical Materials Activity Newport (Chem Demil - CMA NEWPORT)	Program required by treaty and by the Congress.	Army	2004
33	ATCCS-CHS	Army Tactical Command and Control System-Common Hardware and Software (ATCCS-CHS)	ATCC-CHS was an MDAP for about one year;continued as part of ATTCCS.	Army	
34	WIN-T INC 3	Warfighter Information Network-Tactical Increment 3 (WIN-T Inc 3)	Split--part of the original WIN-T	Army	2009-2012
35	WIN-T INC 2	Warfighter Information Network-Tactical Increment 2 (WIN-T Inc 2)	Split--part of the original WIN-T	Army	2007-2012
36	WIN-T INC 1	Warfighter Information Network-Tactical Increment 1 (WIN-T INCREMENT 1)	Split--part of the original WIN-T	Army	2007-2011

Computation of the CLC PAUC Growth Estimates

A. MDAP short name.
B. Program base year (BY) used in stating constant-dollar magnitudes. All dollar magnitudes in Table A-4 are in millions of BY$. Dollar magnitudes and quantities are on a fiscal year basis.
C. MS II/B baseline quantity (Q). Also referred to as MS II/B "total inventory objective."
D. MS II/B baseline quantity to be acquired with RDT&E funds.
E. MS II/B baseline quantity to be acquired with procurement funds.
F. Current Estimate (CE) quantity.
G. CE quantity to be acquired with RDT&E funds.
H. CE quantity to be acquired with procurement funds.
I. CE recurring flyaway in millions of BY$.
J. Compute first unit cost for an assumed learning curve parameter of β= 0.94:

$$C = TQ^{\beta} \quad , \qquad (1)$$

where C is recurring flyaway cost, T is first unit cost, Q is total quantity acquired with procurement funds, and β is the cost progress parameter. Solve this and use the CE for recurring flyaway:

$$\tilde{T} = CQ^{-\beta} \quad . \qquad (2)$$

K. CE recurring flyaway normalized to the MS II/B quantity. Use the computed $\tilde{T}$ in Equation (1) with β= 0.94 and the MS II/B Q acquired with procurement funds. If that is unavailable, use the total MS II/B quantity.
L. CE Non-Recurring flyaway.
M. CE Support costs.
N. CE Support cost times the ratio of MS II/B quantity and CE quantity.
O. CE RDT&E.
P. MS II PAUC (as reported in the SAR)
Q. CE PAUC (as reported in the SAR)
R. CE PAUC normalized to the MS II/B quantity. Add columns K, L, N, and O and divide by the MS II/B quantity.
S. Quantity normalized PAUC growth rate. [(R/P – 1)x100%]

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Program	BY$	MS II/B Q	MS II/B Q-RDTE	MS II/B Q-Proc	CE Q	CE Q-RDTE	CE Q-Proc	CE Recurring Flyaway	T-hat	Recurring Flyaway @ MS II/B Q	CE Nonrecurring Flyaway	CE Support	Scaled Support	CE RDT&E	MS II PAUC	CE PAUC	CE PAUC @ (MS II/B Q	CLC PAUC Growth
E-2C Reproduction	1994	36			44	0	44	3,344.70	97.71567	2782.84	69.8	0	0.0	451	72.99	87.85	91.77	25.7%
AEHF Satellite	2002	5			4			4,744	1,271.79	5845.59	0	0	0.0	6,726.9	1,055.84	2,303.78	2514.50	138%
AGM-88E AARGM	2003	1,790			1,919			928.1	0.865203	871.09	38.4	54.1	50.5	620.2	0.75	0.86	0.88	18%
AH-64E Remanufacture	2010	602			639	5	634	8,073.6	20.49927	7646.42	178.1	1,822.6	1,717.1	1,496.4	11.74	18.11	18.34	56%
AIM-9X Sidewinder	1997	10,049			3,142	45	3,097	703.1	0.41829	2027.30	45.8	26.4	84.4	546.7	0.25	0.42	0.27	8%
B-2 EHF Inc. 1	2012	21			20	4	16	119.2	7.181178	124.67	0	8.5	8.9	443.2	34.21	28.545	27.47	-20%
B-2 RMP	2008	21			20	7	13	460.6	27.74875	481.75	47	37.4	39.3	666.8	60.657	60.59	58.80	-3%
Bradley Upgrade	2001	1,602			2,641	0	2,641	6,930.7	4.830095	4395.3872	26	579.6	351.58	532.7	2.146	3.055	3.3	54%
C-130J	1996	11			168	0	168	9,336.8	80.15838	766.56	133.5	2,133	140	301.8	66.427	71.707	122.0	83.6%
C-5 RERP	2008	126			52			4,340.9	108.8305	9748.71	0	893.4	2,164.8	1,691.9	81.96	133.29	107.98	32%
CH-47F	2005	302			532	2	530	11,251.8	33.76244	6714.7886	339.2	741.3	420.8	183.3	9.283	23.526	25.36	173%
CH-53K	2006	156	4	152	200	4	196	13,061.8	97.4234	10357.161	416.4	2,322.2	1,800.9	5,502.5	96.03	106.7	115.88	21%
EA-18G	2004	90			135	0	135	7,997.1	83.82583	5521.96	161.2	1,222	814.7	1,702.8	85.14	82.256	91.12	7.0%
EELV (Atlas V & Delta IV)	2012	181	0	181	152	1	151	59,078.4	559.0722	69703.83	0	0	0.0	2,365.1	220.644	404.234	398.17	80%
FAB-T	2002	216	25	191	246	30	216	1,290.1	8.806115	1153.15	0	452.7	400.3	1,895.7	13.34	14.79	15.97	19.7%
GMLRS/GMLRS AW	2003	43,182			43,936	376	43,560	4,328.1	0.232986	4260.401	58.4	30.6	30.07	771.9	0.034	0.118	0.1	248.8%
JASSM Baseline	2010	2,469			2,040	87	1,953	1,417.9	1.250194	1687.16	0	407.5	493	1,228.9	0.914	1.497	1.38	51.1%
JDAM	1995	88,126			241,890	804	241,086	4,382.8	0.049901	1747.35	0	390	142	572.7	0.031	0.022	0.0	-9.9%
Joint MRAP	2008	15,771			26,552	257	26,295	25,090.7	2.136723	15,612.13	0	13,835	8,217.5	642.4	1.66	1.49	1.55	-6.5%
JPATS	2002	712			752	1	751	3,406.7	7.456888	3,241.17	56.4	859	814	308.7	4.439	6.286	6.2	39.8%
JTRS HMS	2011	328,674			271,202			5,604.2	0.057495	6,676.29	19.5	1,627.9	1,972.9	1,185.7	0.03	0.031	0.03	-0.1%
LGM-30 Minuteman III PRP	1994	607			601	0	601	1714.5	4.603372	1730.0934	26.7	134	134.83	316.2	3.438	3.645	3.64	5.8%
LUH	2006	322			315	0	315	1,513	7.320642	1,543.63	19.1	91.6	93.6	3.2	5.09	5.17	5.15	1.3%
NAS	2005	53			88	0	88	907.7	14.0652	570.88	0	351.3	211.6	135.1	14.27	15.842	17.31	21.3%
P-8A	2010	115			122	5	117	19,153.7	220.2165	18,147.52	388.6	3,713.4	3,500.3	8,170.8	263.234	260.531	262.67	-0.2%
SM-6	2004	1,200			1,800			5,561	5.495465	3,843.46	24.1	839.5	559.7	834.5	4.06	4.03	4.38	8.0%
Stryker	2004	2,096			4,536	29	4,507	8,088.2	3.44395	4,003.49	1,897.9	3,310	1,529	1,001.6	3.218	3.251	4.0	25.0%
T-AKE	2000	12			14	0	14	5,204.5	435.5373	4,513.97	97.2	-	-	26.0	355.217	380.55	386.4	8.8%
UH-60M Black Hawk	2005	1,221			1,375	8	1,367	18,309.7	23.12584	16,431.62	199.8	1,062	943	761.3	9.25	14.787	15.0	62.3%
WGS	2001	3	0	3	8	0	8	3,367.9	473.0552	1346.592	0	33	12	444.3	387.4	480.625	601.1	55.2%

Computation of the DLC PAUC Growth Estimates

A. MDAP short name.
B. Program base year (BY) used in stating constant-dollar magnitudes. All dollar magnitudes in Table A-4 are in millions of BY$. Dollar magnitudes and quantities are on a fiscal year basis.
C. Date of the SAR from which the CE is taken.
D. MS II/B baseline quantity (Q). Also referred to as MS II/B "total inventory objective."
E. MS II/B baseline quantity to be acquired with RDT&E funds.
F. MS II/B baseline quantity to be acquired with procurement funds.
G. Current Estimate (CE) quantity.
H. CE quantity to be acquired with RDT&E funds.
I. CE quantity to be acquired with procurement funds.
J. DAMIRS staff estimate of first unit cost.
K. DAMIRS staff estimate of β
L. CE recurring flyaway normalized to the MS II/B quantity.
M. CE Non Recurring flyaway.
N. CE Support costs.
O. CE Support cost times the ratio of MS II/B quantity and CE quantity.
P. CE RDT&E.
Q. MS II/B PAUC (as reported in the SAR)
R. CE PAUC normalized to the MS II/B quantity. Add columns K, L, N, and O and divide by the MS II/B quantity.
S. CE PAUC (as reported in the SAR)
T. Quantity normalized PAUC growth rate. [(R/Q – 1)x100%]

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Program	BY$	CE	MS II/B Q	MS II/B Q RDTE	MS II/B Q Proc	CE Q	CE Q RDT&E	CE Q Procurement	DLC a	DLC b	Recurring Flyaway @ MS II/B Q	CE Non-recurring flyaway	CE Support	Scaled CE Support	CE RDT&E	MS II/B PAUC	CE PAUC @ MS II/B Q	CE PAUC	DLC PAUC Growth
CEC	2002	12/25/2011	183			269	30	239	23.64	-0.35	1,041.49	-	244.00	166.00	2,738.60	13.33	21.56	16.33	62%
F/A-18E/F	2000	12/25/2011	1,000			565	0	565	155.93	-0.19	51,728.30	1,482.90	7,114.00	12,591.00	5,895.20	65.94	71.70	82.395	9%
F-22	2005	12/25/2009	648			188	9	179	413.13	-0.26	66,741.63	2,278.40	5,622.00	19,378.00	34,898.10	122.71	190.27	366.731	55%
FBCB2	2005	12/25/2009	59,522			90,068	0	90,068	0.13	-0.18	1,235.00	5.40	568.00	375.23	708.50	0.04	0.04	0.04	-5%
GBS	1997	12/25/2011	346	221	125	1,916	136	1,780	0.34	-0.05	93.96	105.80	26.00	4.75	395.70	1.31	1.73	0.483	33%
H-1 UPGRADES	2008	12/25/2011	284			353	4	349	22.11	-0.01	6,020.84	973.20	1,675.10	1,347.70	1,870.90	12.09	35.96	33.792	197%
HIMARS	2003	12/25/2011	894			381	6	375	5.29	-0.10	2,623.00	19.10	266.00	623.45	242.00	4.15	3.92	4.617	-6%
JAVELIN	1997	12/25/2006	70,631			25,119	57	25,062	0.39	-0.15	6,303.33	107.10	352.00	990.00	874.50	0.05	0.12	0.173	134%
JSOW BASELINE/BLU-108	1990	12/25/2011	8,800			3,334	0	3,334	1.29	-0.25	1,569.79	177.00	21.60	57.01	563.60	0.21	0.27	0.444	26%
JSOW UNITARY	1990		7,800			7,000	0	7,000	0.54	-0.10	1,836.11	152.80	9.40	10.47	348.70	0.43	0.30	0.306	-30%
LPD 17	1996	12/25/2011	12	0	12	11	0	11	1,492.77	-0.09	15,337.45	68.70	-	-	116.10	751.51	1,293.52	1,297.21	72%
MH-60R	2006	12/25/2011	254			291	2	289	37.75	-0.06	7,424.00	1,234.40	1,717.50	1,499.00	1,818.20	26.16	47.15	44.955	80%
MH-60S	1998	12/25/2011	166			275	0	275	15.84	-0.02	2,414.37	965.00	1,050.80	634.00	680.30	16.68	28.28	24.106	70%
MIDS	2003	12/25/2011	672			5,258	441	4,817	0.43	-0.10	167.32	72.60	194.00	25.00	1,573.80	1.63	2.74	0.533	68%
Tactical Tomahawk	1999	12/25/2011	1,365			4,961	10	4,951	1.35	-0.03	1,516.27	35.30	91.00	25.00	565.10	1.23	1.57	1.153	27%

A. MDAP short name.
B. MS II/B baseline quantity (Q). Also referred to as MS II/B "total inventory objective."
C . Current Estimate (CE) quantity
D. MS II PAUC (as reported in the SAR)
E. CE PAUC (as reported in the SAR)
F. PAUC growth rate. [((E-D)/D)x100]

A	B	C	D	E	F
Program	**MS II/B Q**	**CE Q**	**MS II/B PAUC**	**CE PAUC**	**PAUC Growth**
AH-64D Apache Airframe (Longbow Apache)	758	757	6.932	15.027	117%
Cheyenne Mountain Upgrade	1	1	1,581.00	1,750.60	11%
Cobra Judy Replacement	1	1	1365	1,524.8	12%
CVN 21/CVN 78	3	3	9,567.07	8,466.33	-12%
E-2D AHE	75	75	189.977	243.641	28%
F-35 JSF	2,457	2,457	74.57	108.24	45%
LGM-30 Minuteman III GRP	652	652	2.25	3.21	43%
MUOS	6	6	956.333	1,007.6	5%
SBIRS (Space Based IR Sensor) High*	2	2	693.98	2,774.9	300%
SBSS Block 10	1	1	810.5	902.8	11%
SDB	24,070	24,070	0.063	0.052	-17%
SSGN (Ohio Class Conversion)	4	4	967.275	966.85	0%
SSN 774 Virginia Class New Attack Sub	30	30	1,521.10	2,017.94	33%
PAC-3**	1200	1354		7.656	130%

*The SBIRS High MS II baseline quantity was five, composed of three satellites purchased with RDT&E funds and two purchased with procurement funding. The CE PAUC reported in the December 2012 SAR reflects two RDT&E satellites and two procurement satellites. (See the Unit Cost report on p. 41 of the December 2012 SBIRS-High SAR.) We assumed that the RDT&E satellites did not show any reduction of unit cost with increased quantity. Since the number of procurement funded satellites did not change, no quantity normalization is required to compute PAUC growth.

**The CE PAUC for PAC-3 is in BY2002$. The first SAR and the December 2012 SAR for PAC-3 do not report an MS II PAUC in BT2002$. The December 2012 SAR does report a Development Estimate PAUC and a CE PAUC in then year dollars—3.530 and 8.129, respectively (p.27 of the December 2012 SAR). We used these to compute PAUC growth. This PAUC growth is not quantity normalized but the increase in quantity is modest—about 130 percent.

Program	MS II/B	Last SAR	PAUC Growth
AFATDS	1989	1998	0.02
M1A2 Abrams Tank Upgrade	1989	2003	0.32
E-3 Sentry AWACS RSIP	1989	2003	0.48
ATCCS-CSSCS	1991	1998	0.04
Longbow Hellfire	1991	2004	0.12
SMART-T	1992	2002	0.28
T-AKR 295 Strategic Sealift	1993	2001	0.04
ATCCS-ASAS BLK II/III*	1993	1998	0.49
AV-8B Harrier Remanufacture	1994	2002	0.02
B-1B CMUP	1995	2004	-0.12

1989-2001

Cost Growth of Major Defense Programs

John McCrillis
OSD CAIG

ADoDCAS Williamsburg, Virginia

30 January, 2003

Agenda

- Background
- Methodology
- Results
- Website

CG History

- Ongoing for ten years
  - OSD: Dave McNicol, Gary Bliss, Jerry Pannullo, Mark Daley, and John McCrillis
  - NAVSHIPSO Philadelphia: Bob Ellwood and Chuck Buchinski
  - AT&T: JoOn Yang
- Various presentations to date

So Why Now?

- More systems
  - 142 MS II
- Converted MS Excel to MS Access
  - Transportable to other databases
  - Avoids calculation errors inherent with Excel
    - Charting remains in Excel
- Added PNO, Subcategory's, and Schedule
- Website

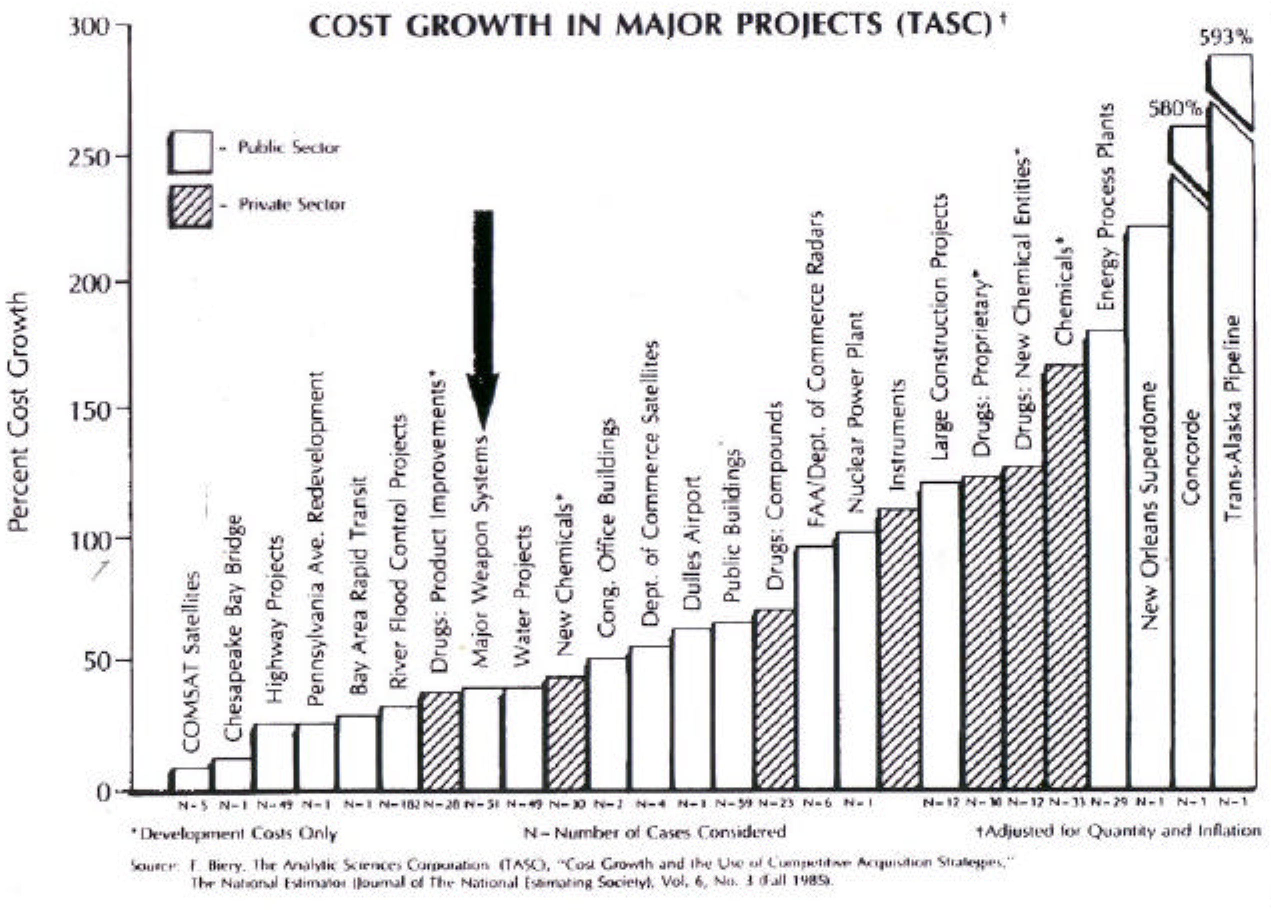
What is CG?

- Difference between today's estimate and a baseline estimate caused by:
  - Poor initial estimate
    - Ill defined program
  - Different program than originally conceived
    - Different procurement quantities
    - Requirement changes
  - Inefficiencies
    - Too many people
    - Too much money
    - Lack of focus
  - Other

Why Do The Study?

- Is there a problem?
  - If so, where is it?
- What are the primary growth areas?
  - Is there an initiative that can be taken to correct the problem?
- Is there an estimation problem?
- How much of a technical problem is there?
- Can I use the past to predict the future?

DoD vs. the World



CG Definition

- Current estimate/baseline estimate
- For our study
  - Baseline est = total program cost adjusted for inflation at a fixed point in time
  - Current est = total program cost adjusted for inflation and quantity variation

Study Objective

- Identify how much of cost growth is attributable to:
  - Decisions = Discretionary changes to the system relative to the description at Milestone 2
  - Mistakes = Changes not attributable to discretionary changes post Milestone 2
- Establish a historical record for comparison

Data Source

- SARs (Selected Acquisition Reports)
  - Contains
    - Descriptions
    - Schedule
    - Official DoD cost estimate
      - RDT&E, Procurement and MilCon
      - No O&M
    - Actuals to date
    - Procurement numbers
    - Incremental changes from previous SAR estimate
      - Variances
  - Prepared annually or quarterly if significant changes

Major Defense Acquisition Programs (MDAPs)

- Eventual RDT&E total > $365 CY00 or
- Eventual Procurement total > $2.19B CY00 or
- Designated by Secretary

- Either Acquisition Category (ACAT) 1D or 1C

Scope

- 286 programs submitted SARs since 1969
- 187 entered into database
- 142 met study criteria
  - Unclassified
  - Milestone 2 captured
  - Three years of data past milestone 2
  - Data complete

System Count

Service	A	F	N	J	Total
Aircraft	6	20	15	1	42
C4ISR	12	5	7		24
Ground	14				14
Missile	10	9	11	4	34
Ship			19		19
Space		8	1		9
Total	42	42	53	5	142

Systems Names (1)

Aircraft		C4ISR
A-10 Thunderbolt	F-16 Falcon	ADDS EPLRS (Enhanced Pst Location Rpt Sys)
A-6E/F Intruder	F-22 ATF	AEGIS MK-7
AH-64 Apache	F-5E Tiger	AFATDS (Adv Field Artilleray Tact Data Sys)
AH-64D Apache Airframe	JTUAV Short Range Hunter	ALQ-165 ASPJ (Jammer)
AH-64D Apache FCR	KC-135R Stratotanker	ALQ-212(V) ATIRCM/CMWS
AV-8B Harrier	LANTIRN (Low Alt Nav & Targeting Sys)	ARC-210 SINCGARS Radio
AV-8B Harrier Remanufacture	LGM-30 Minuteman III GRP	ATCCS ASAS Blk II/III
B-1B Lancer	LGM-30 Minuteman III PRP	ATCCS CSSCS
C-130J Hercules	MH-60R Strikehawk	ATCCS FAAD C2I
C-17A Globemaster	RPV Aquila	CEC (Coop Engagment Capability)
C-5B Galaxy	SH-60B LAMPS Mk III	E-3 Sentry AWACS RSIP
CH-47 Chinook	SH-60F CV Helo	FPS-118 OTH-B (Over Horizon Backscatter Radar)
CH-53 Super Stallion & MH-53 Sea Dragon	T-45 Goshawk Training System	JSTARS GSM
CSRL (Rotary Launcher)	T-46A Eaglet Trainer	JSTARS USAF
E-2C Hawkeye AEW	T-6A JPATS (Jt Prmy AC Training Sys)	JTIDS (Tact Info Dist Sys)
E-3A Sentry AWACS	TRN-45 MMLS Ground Components	JTIDS DTDMA USN
E-4 AABNCP NEACP	UH-60A Blackhawk	MIDS LVT (Low Vol Terminal)
E-6A TACAMO	V-22 Osprey USN	MSE (Mobile Subscriber Equipment)
EA-6B Prowler ICAP		NAS (National Airspace System)
EF-111A TJS		SMART-T (Secure Mobile Terminal)
F/A-18 E/F Super Hornet		SQR-19 TACTAS
F/A-18 Hornet		SYQ-23 JSIPS (Jt Ser Imagery Proc Sys)
F-14D Tomcat		TTC-39 Nodal Comm Switch
F-15 Eagle		USQ-84(V) SOTAS (Target Acquistion Sys)

Systems Names (2)

Missile		Ground Combat
AGM-114 Hellfire	Navy Area TBMD	ATACMS Blk I (APAM)
AGM-114K Hellfire Longbow	RGM-109 Tomahawk BIP (Baseline Imp Prgm)	ATACMS Blk II/IIA
AGM-131A SRAM II (Short Range Msl)	RGM-109 Tomahawk MMM (Multi Mission Msl)	Crusader Field Artillery Sys
AGM-65D Maverick IR	RIM-67 Standard Missile II	DIVAD (SGT York)
AGM-84A Harpoon	SADARM 155mm Projectile	FAADS LOS-F-H ADATS
AGM-86B ALCM	SADARM Rocket	FAADS LOS-R Avenger
AGM-88 HARM USAF		FMTV (Family Med Tact Vehicles)
AGM-88 HARM USN	**Ship**	M1 Abrams Tank
AIM-120 AMRAAM	CG 47 Aegis Cruiser	M198 155MM Howitzer
AIM-54C Phoenix Missile	CVN-71 Roosevelt	M1A2 Abrams Tank Upgrade
AIM-7M Sparrow (USAF)	CVN-72/73 Lincoln & Washington	M2/M3 Bradley FVS
AIM-7M Sparrow (USN)	CVN-74/75 Stennis & Truman	M2/M3 Bradley FVS Upgrade
AIM-9L Sidewinder	CVN-76 Reagan	M26 MLRS (Mult Launch Rocket Sys)
AIM-9L Sidewinder (USN)	CVN-77	PLS FHTV (Palletized Load System)
AIM-9M Sidewinder	DDG-51 Burke	
AIM-9X Sidewinder	FFG-7	**Space**
ATACMS P3I (BAT)	LCAC (Landing Craft Air Cushion)	DSCS-III (Def Sat Comm Sys)
BGM-109G Tomahawk GLCM	LHD 1 Amphibious Assault Ship	GBS (Global Broadcast Service)
BLU-108 JSOW AIWS	LPD 17 Amphibious Transport Dock Ship	GPS NAVSTAR
BLU-108 JSOW Unitary	LSD 41 Whidbey Island	IUS (Inertial Upper Stage)
CBU-97B SFW (Sensor Fuzed Weapon)	LSD 41 Whidbey Island Cargo Variant	LGM-118A Peacekeeper
FGM-148A Javeline AAWS-M	NATO PHM Pegasus Class	LGM-118A Peacekeeper Rail Garrison
FIM-92 Stinger Missile	SSN 688 Los Angeles	SBIRS (Space Based IR Sensor) High
JDAM (Jt Direct Attack Munition)	SSN 774 Virginia Class New Attack Sub	Titan IV ELV (Expend Launch Veh)
M47 Dragon Guided Missile	T-AKR 295 Strategic Sealift	UGM-133A Trident II Missile
M712 CLGP (Cannon Launched) Copperhead	T-AO 187 Oiler	
MIM-104 Patriot Guided Missile System	Trident II Submarine	
MIM-104 Patriot PAC-3 (Pat Adv Capablity)		

System Categories

- Difficult to identify
- Procurement usually dominates expenditures
  - Categorized based on majority of dollars
  - Not always consistent
    - Some development $ had little to do with procurement $
    - Refinements, redistricting possible
  - Need statistically representative number of systems in each

- What will Future Combat System (FCS) be?

SAR Limitations

- Changes in SAR preparation guidelines
- Errors in math or facts
- Cost sharing in joint programs may be reported in multiple SARs if at all
- Variance categories not always consistent
- Accuracy of programs total cost estimate
- Rebaselining

- Is there something better?

Methodology

- Data collected by NAVSHIPSO and stored in db
  - RDT&E, Proc, & MilCon total estimates by year
    - Only using RDT&E and Proc, too many issues with MilCon
  - Incremental variance data
    - Categorize as a mistakes or decision
    - Verify variances total yearly difference in total estimate
    - Identify as quantity related variance
  - Quantity data
  - Actual procurement $ and quantities to date
  - Schedule data
  - Miscellaneous data like notes and bookkeeping

Mistake Subcategories

- MCEP: Cost estimating production changes
- MCEDE: Cost estimating development engineering
- MILS: ILS spares and support changes
- MSSMF: Schedule changes, and acquisition strategy changes, and management initiatives
- MOTHER: Other discretionary changes

Decision Subcategories

- DRCV: Requirements, configuration, and variant changes
- DSMMI: Schedule, multiyear, and management initiatives
- DILS: ILS changes and spares and support
- DEPF: External program factors (Congress, FMS)
- DOTHER: Other changes not attributable to discretionary changes

Variance Examples

- Mistakes
  - Estimate (MCEP): Increase in flyaway cost due to underestimation of manufacturing hours
  - Engineering (MCEDE): Additional costs for EMD targets, lethality, and OT&E
  - Support (MILS): Underestimation of initial spares
  - Schedule (MSSMF): Delay in start of production
- Decisions
  - Requirements (DRCV): Costs associated with incorporating next generation missile series improvements
  - Schedule (DSMMI): Across-the-board budget cut forces slower production rate
  - Support (DILS): Revised requirements for training devices and spares

Calculations Overview

- Convert all cost data to base year 2000
  - RDT&E, Proc, and MilCon averages for all services
- Normalize current cost estimate to the baseline quantity
  - Apply a learning curve to all variances that are quantity related
  - Ignore all non-quantity related variances
- Add adjusted variances to generate a normalized current estimate

- Results are cost growth factors as of the latest SAR, not time phased

Learning Curve

Calculate yearly unit cost from actual $ proc/# units

Learning_slope = 2^m where:

m = [Duration*sum(x(FY)*y(FY))-sum(x(FY))*sum(y(FY))]/
[Duration*sum(x(FY)^2)-(sum(x(FY)))^2]

Sums are from base to current year

Duration = Current_year - Base_year

X(FY) = log(total_#_units_to_date)

Y(FY) = log(unit_cost_to_date)

Slope Adjustments

- Adjust slope if > 1 or < 0.6
  - A nominal value is .85
  - Program may not have procured anything
  - If the unit cost grows with time (> 1), using a value < 1 like 0.9 will result in more cost growth

Quantity Normalization

- Is the variance quantity related?
- If it is quantity related, is the variance applicable to all quantities?
- If both are true, apply the following correction:

- Adjusted_Var = Var*[(Q_0 + Q_{rdte})^(b+1) - qty^(b+1)]/
- [(Q_c+ Q_{rdte})^(b+1) - Q_{rdte}^(b+1)]
  - where
    - Q_0 = Procurement quantity total for the baseline year
    - Q_{rdte} = RDT&E quantity
    - Q_c = Procurement quantity total current year
    - b = log(m)/log(2) + 1
    - m = learning curve slope

Baseline Year

- Use MS 2 estimate as baseline
  - Difficult to identify if not explicit
  - Contract dates or other knowledge
    - Development contract award date
  - Judgment necessary
- Cost growth can be very sensitive to base year
  - Changing base year can have dramatic changes on some programs
  - Stable programs don’t show much sensitivity

Milestone Definitions

- 1 = proceed with demonstration and validation
- 2 = proceed with engineering, manufacturing, and development (EMD)
- 3 = proceed with production
- A = proceed with concept and technology development
- B = 2
- C = proceed with production and development

- Contract award dates replace MS review date if not identified
- Future will include MS 1 & 3

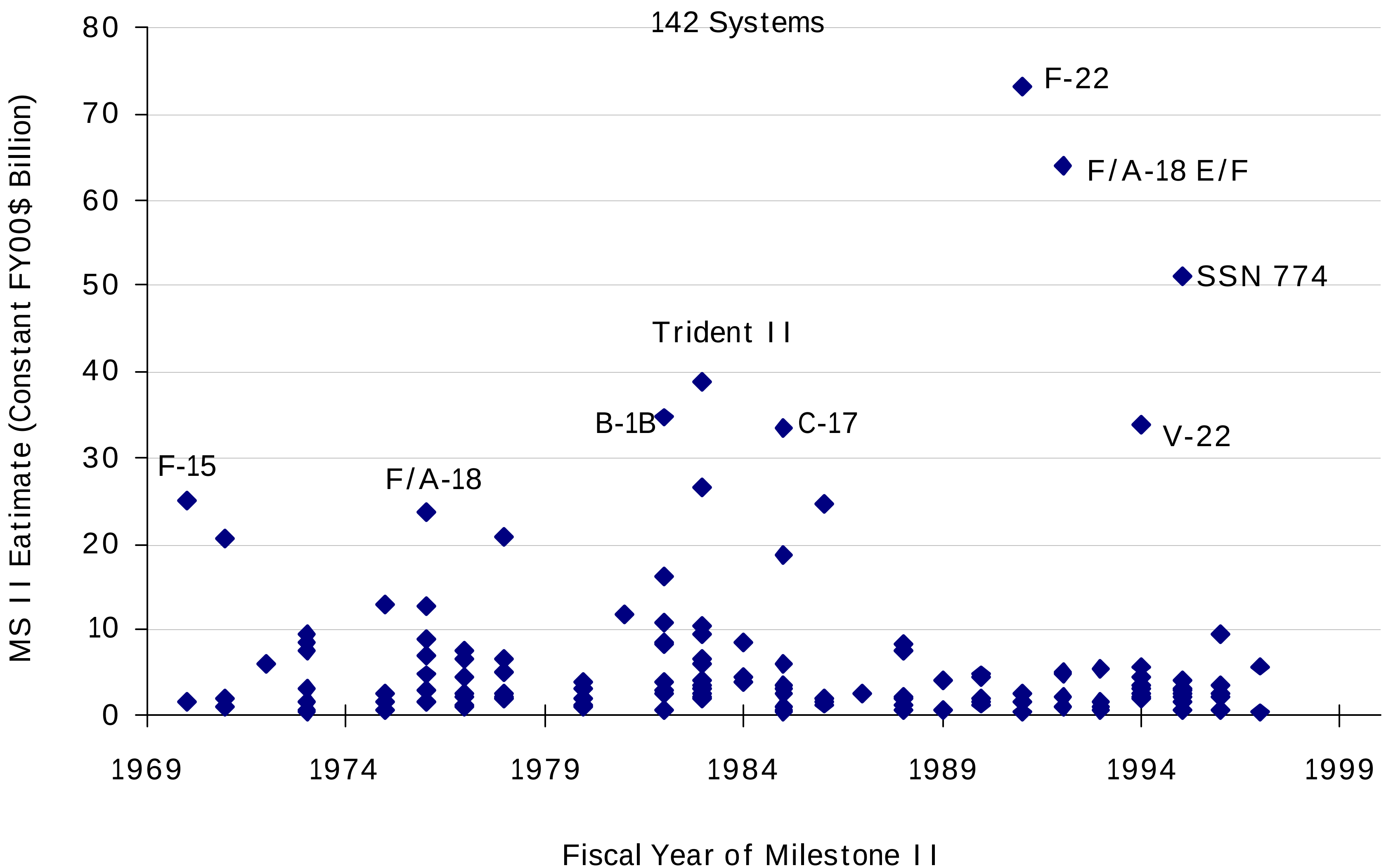
Outputs

- CG is a function of
  - Service(A,F,N,J)
  - Commodity(Aircraft, C4ISR, Ground, Missile, Ship, Space)
    - Aircraft(Large(5), Helicopter(9), UAV(2), System(6), Trainer(3), Electronic(6), Tactical(11))
    - C4ISR(Sensor(10), Command & Control(8), Communication(6))
    - Ground Combat(Ordnance Delivery Sys(7), Tank,(5) Transport(2))
    - Missile(ATA(8), Cruise(4), ATG(7), Projectile(4), STS(5), STA(4), Man Portable(2))
    - Ship(Carrier(6), Combatant(3), Submarine(3), Support(7))
    - Space(Ballistic(3), Rocket(2), Satellite(4))
  - Funding(RDT&E & Proc)
  - Variance category(Mistake(5), Decision(5))
  - Calendar Year
  - Milestone
- Arithmetic and dollar weighted averages

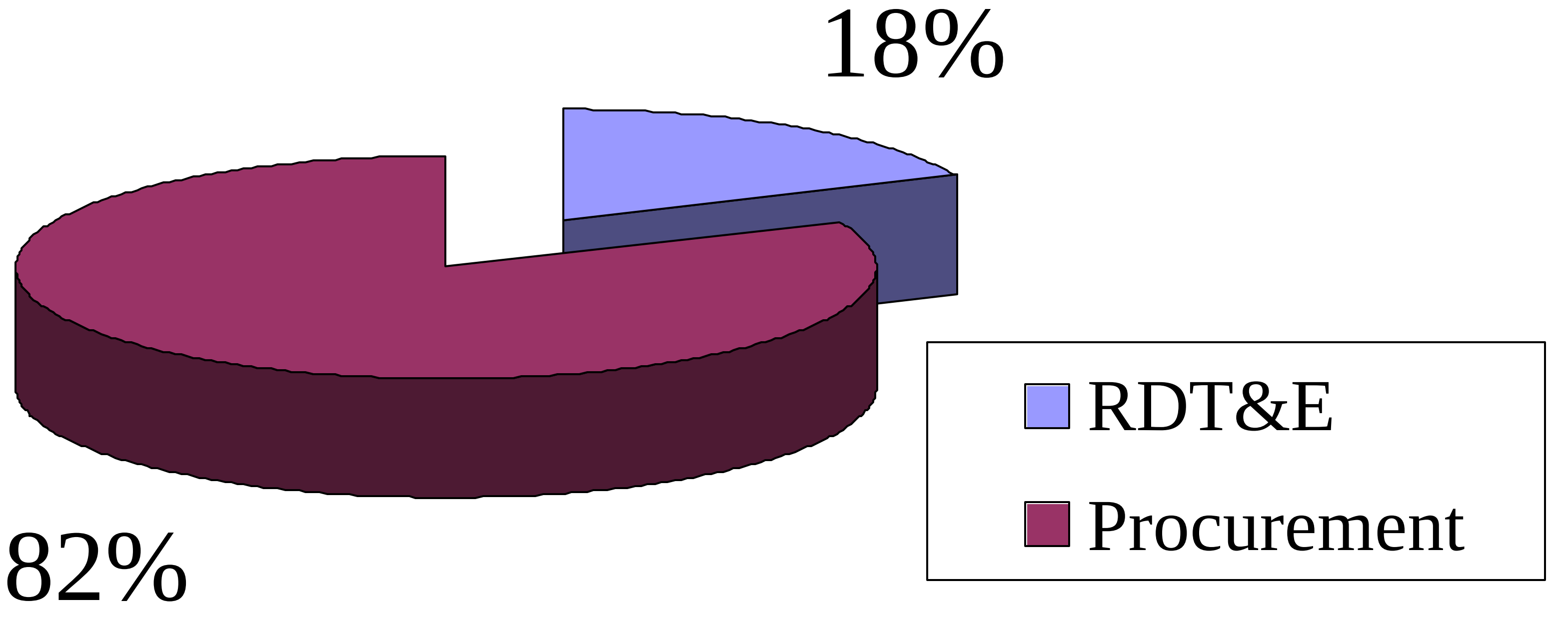
Methodology Conclusions

- Production rate changes may be considered in future studies
  - Not explicitly captured in current calculations

Program Size by FY



Division of Resources

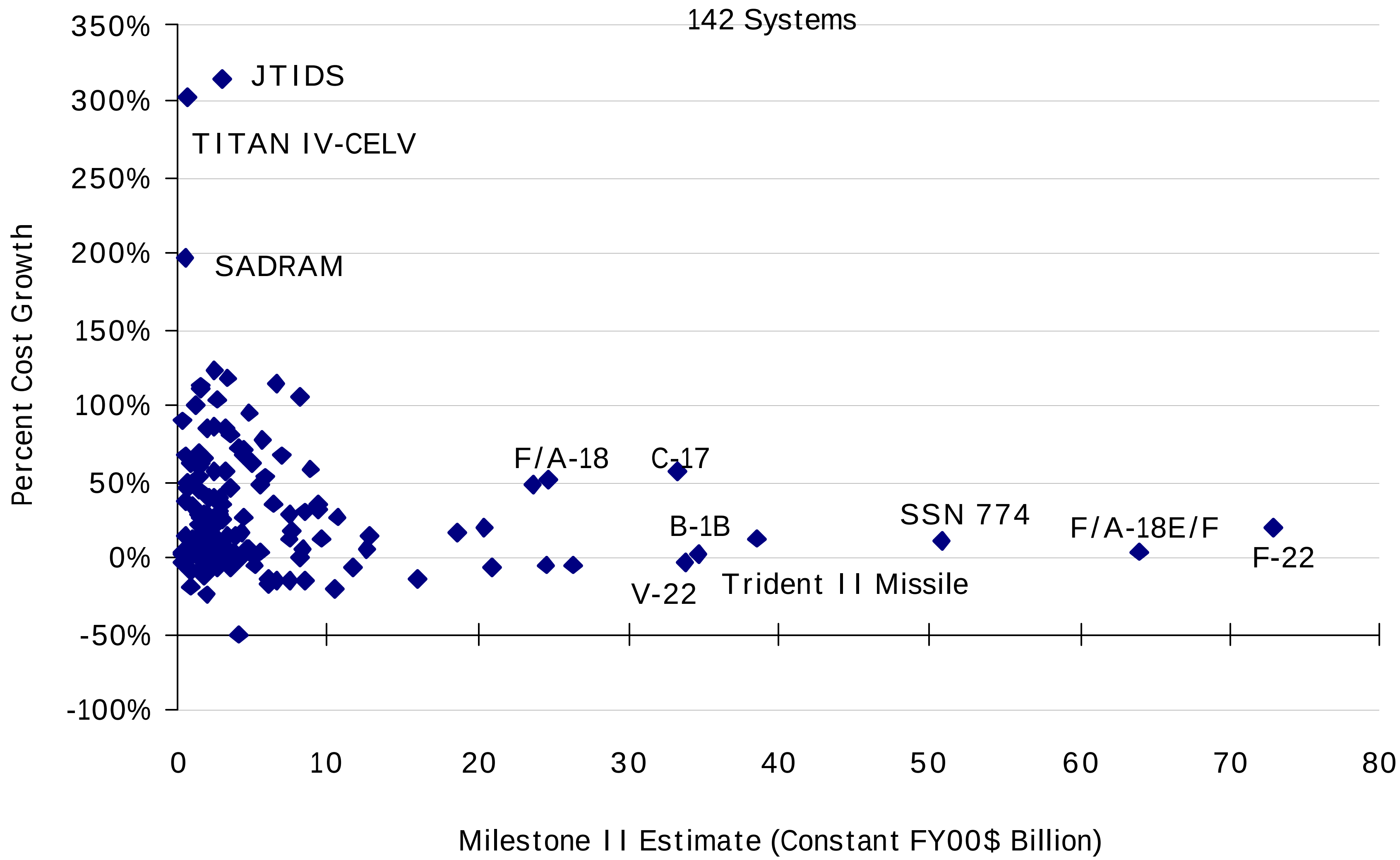


Statistics

	RDT&E	Proc	Total
Minimum	-64%	-54%	-51%
Maximum	471%	327%	315%
Average	45%	29%	32%
Median	27%	13%	18%
Standard Deviation	71%	50%	50%
Dollar Weighted Average	17%	11%	12%
Number Systems	137	138	142

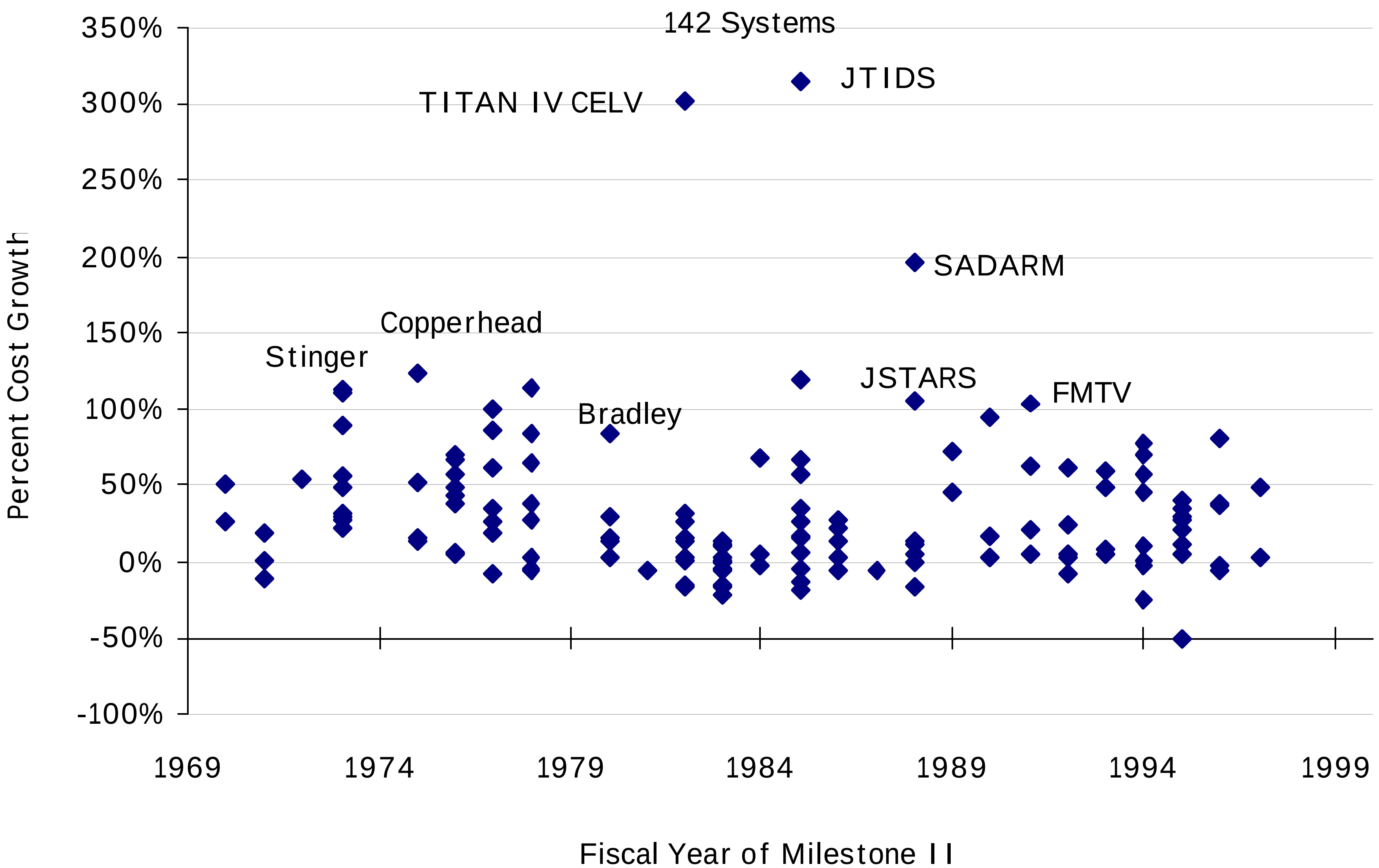
Total CG by Program Size

Do the services budget to cost for large systems and cost to budget for smaller ones?

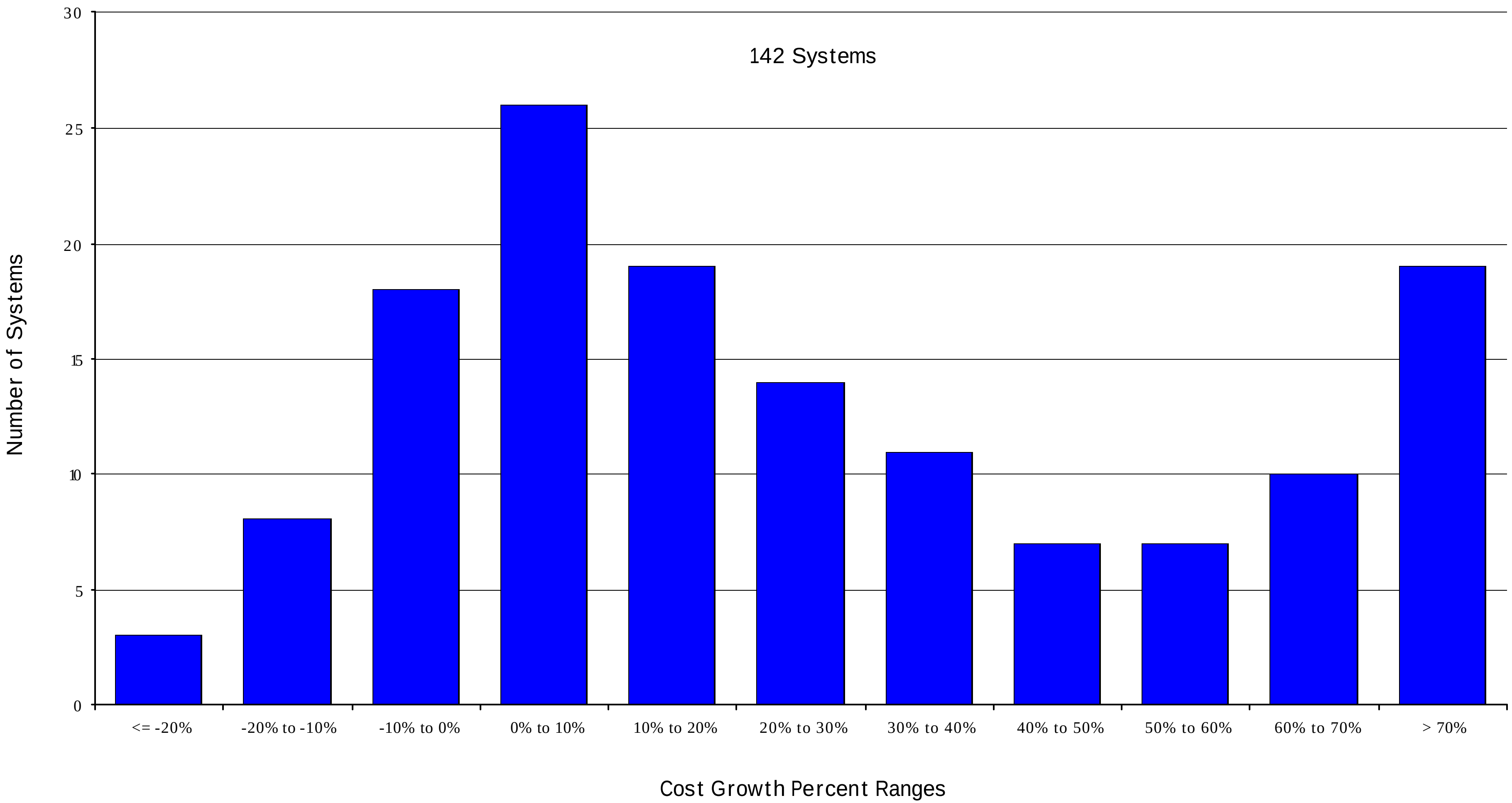


Total CG by Fiscal Year

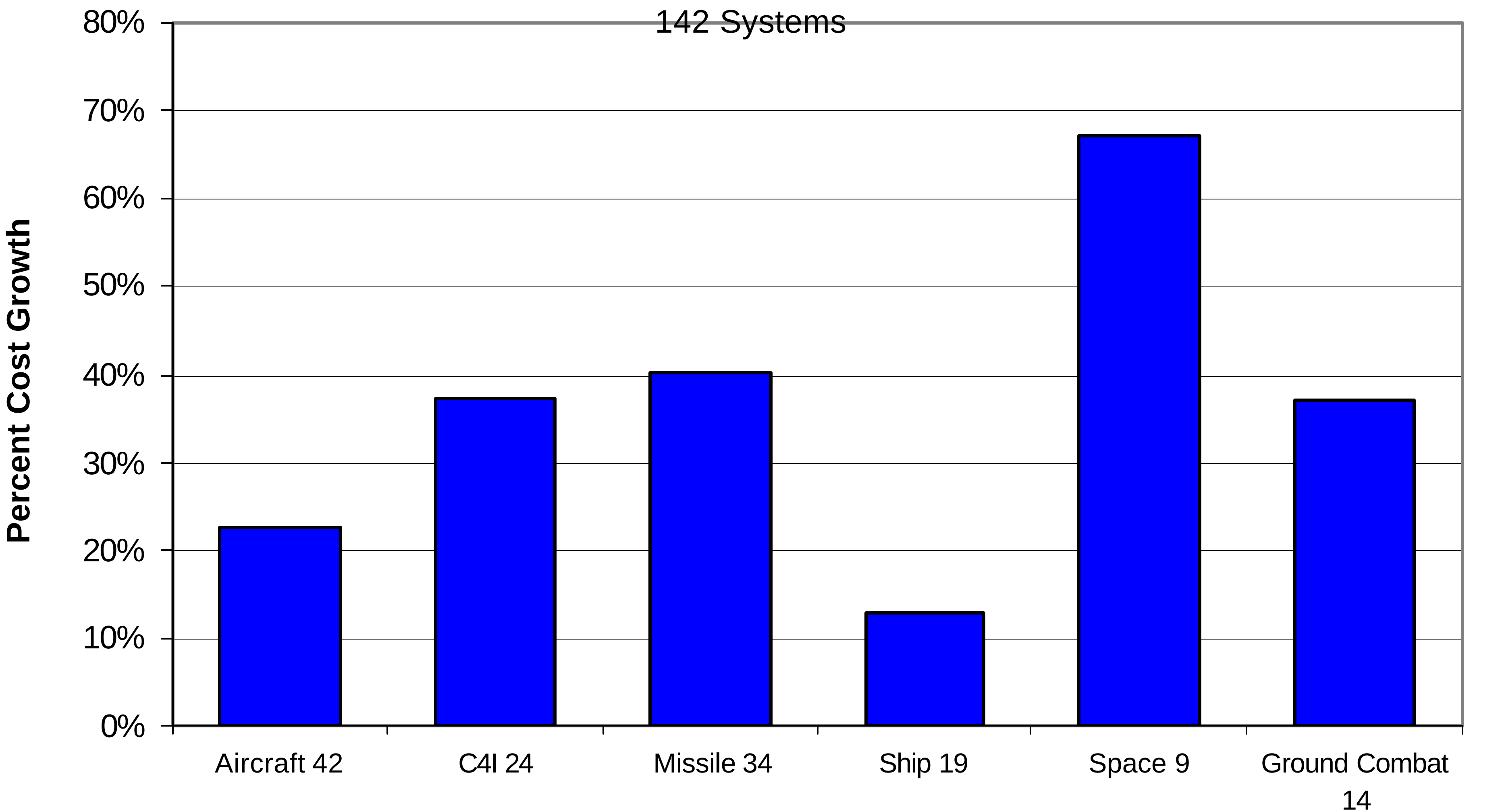
Are we getting any better?



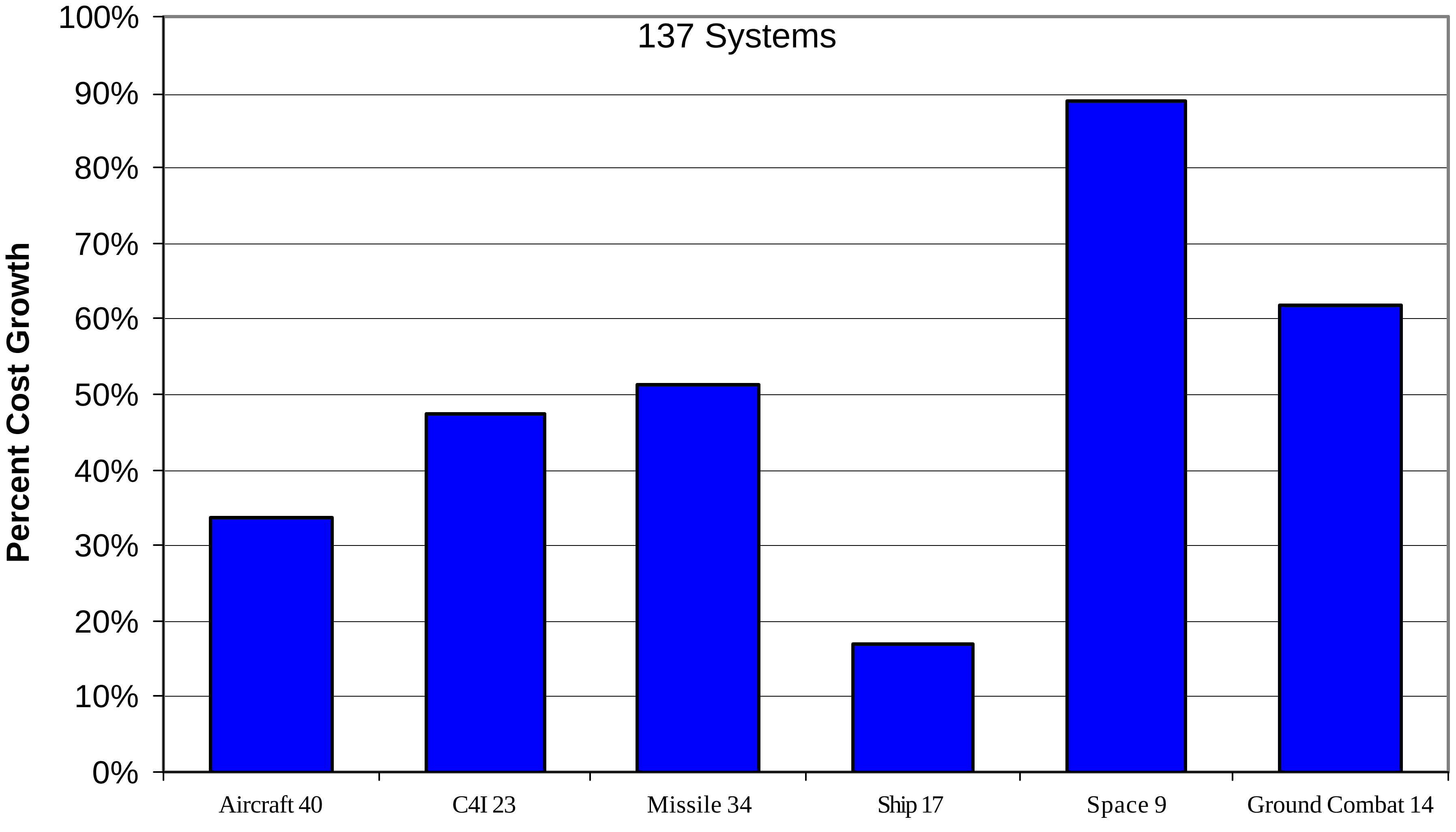
Total CG Distribution



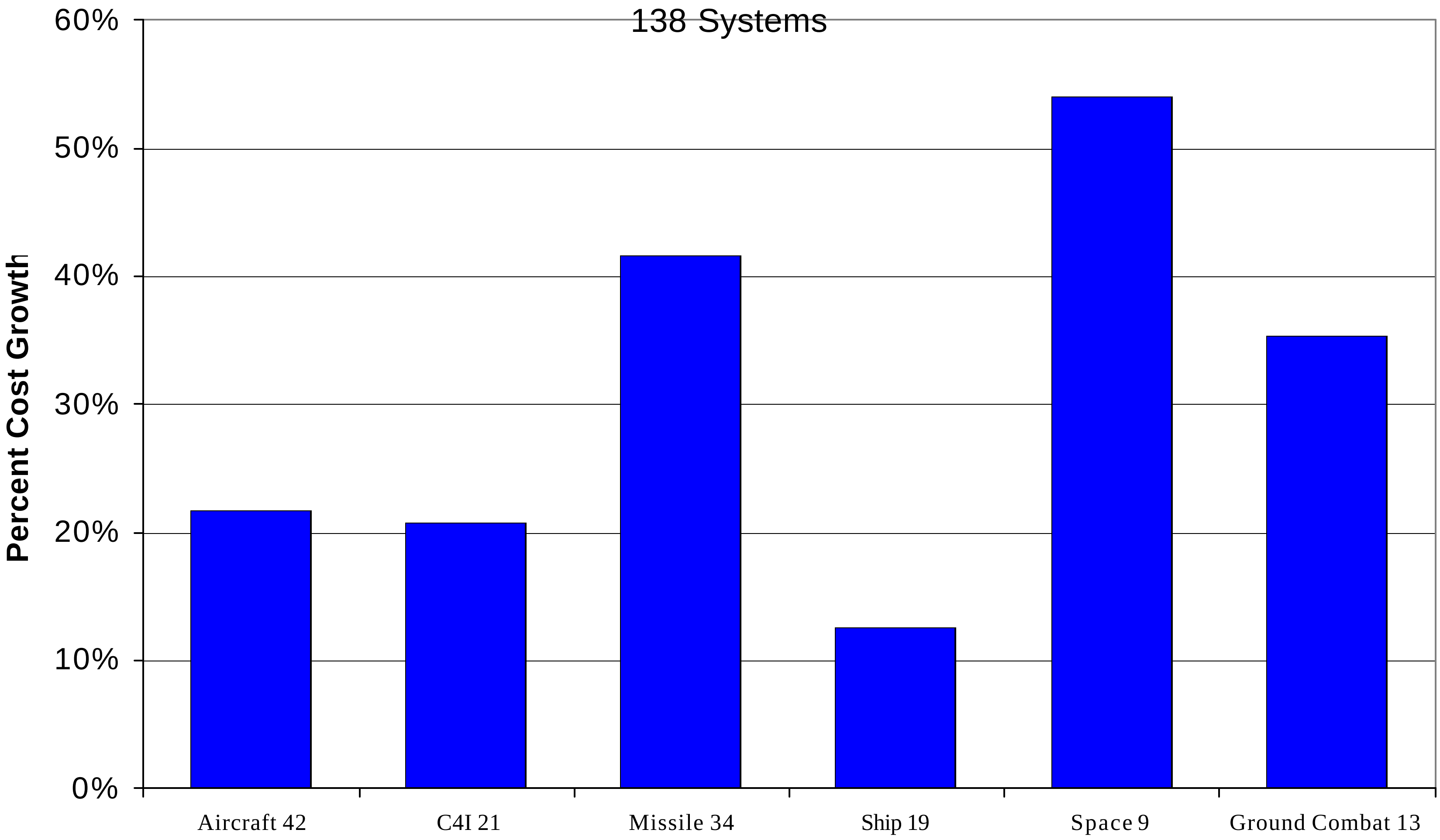
Total CG by Commodity



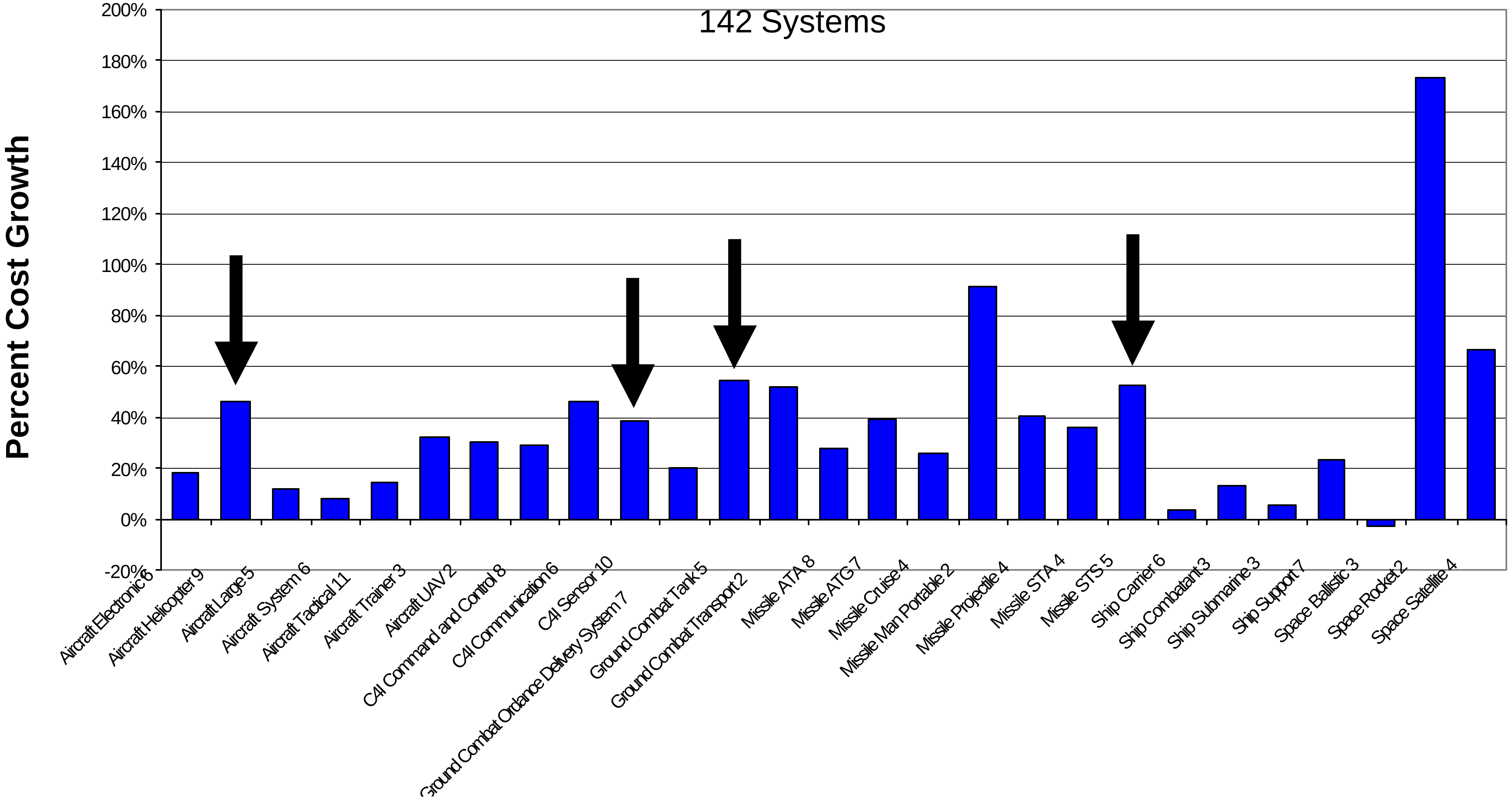
RDT&E CG by Commodity



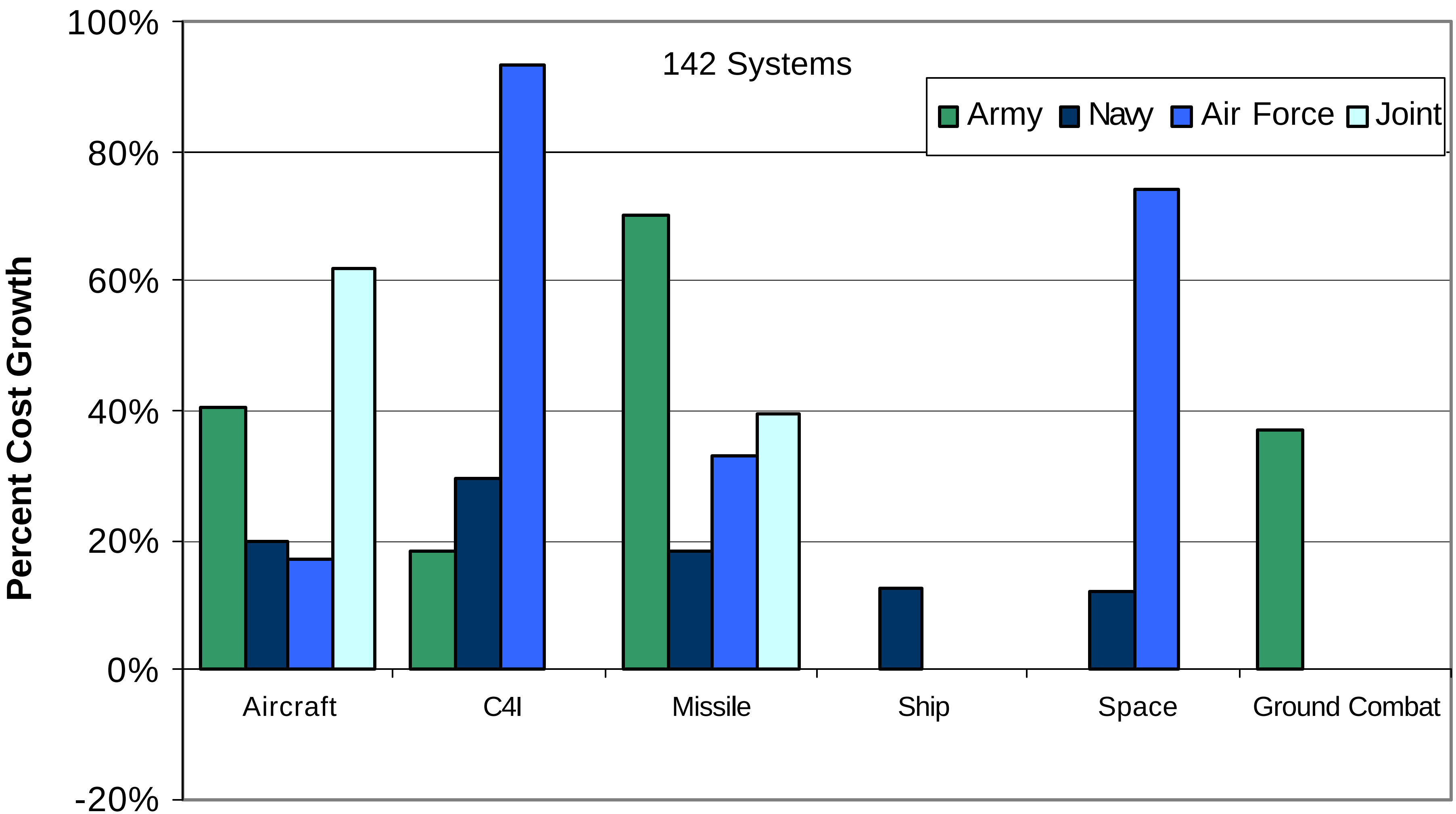
Procurement CG by Commodity



Total CG by Subcommodity

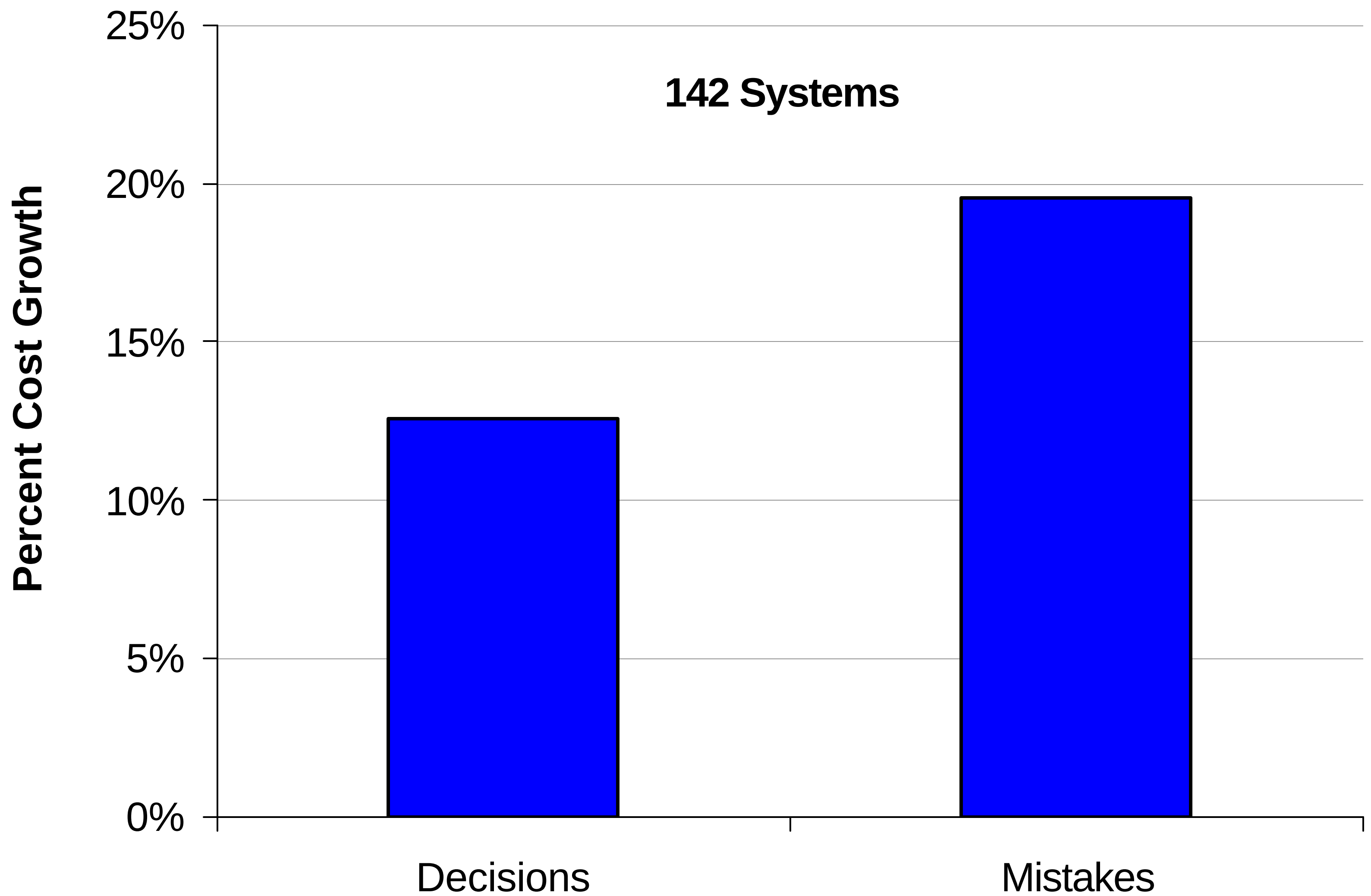


Total CG by Service

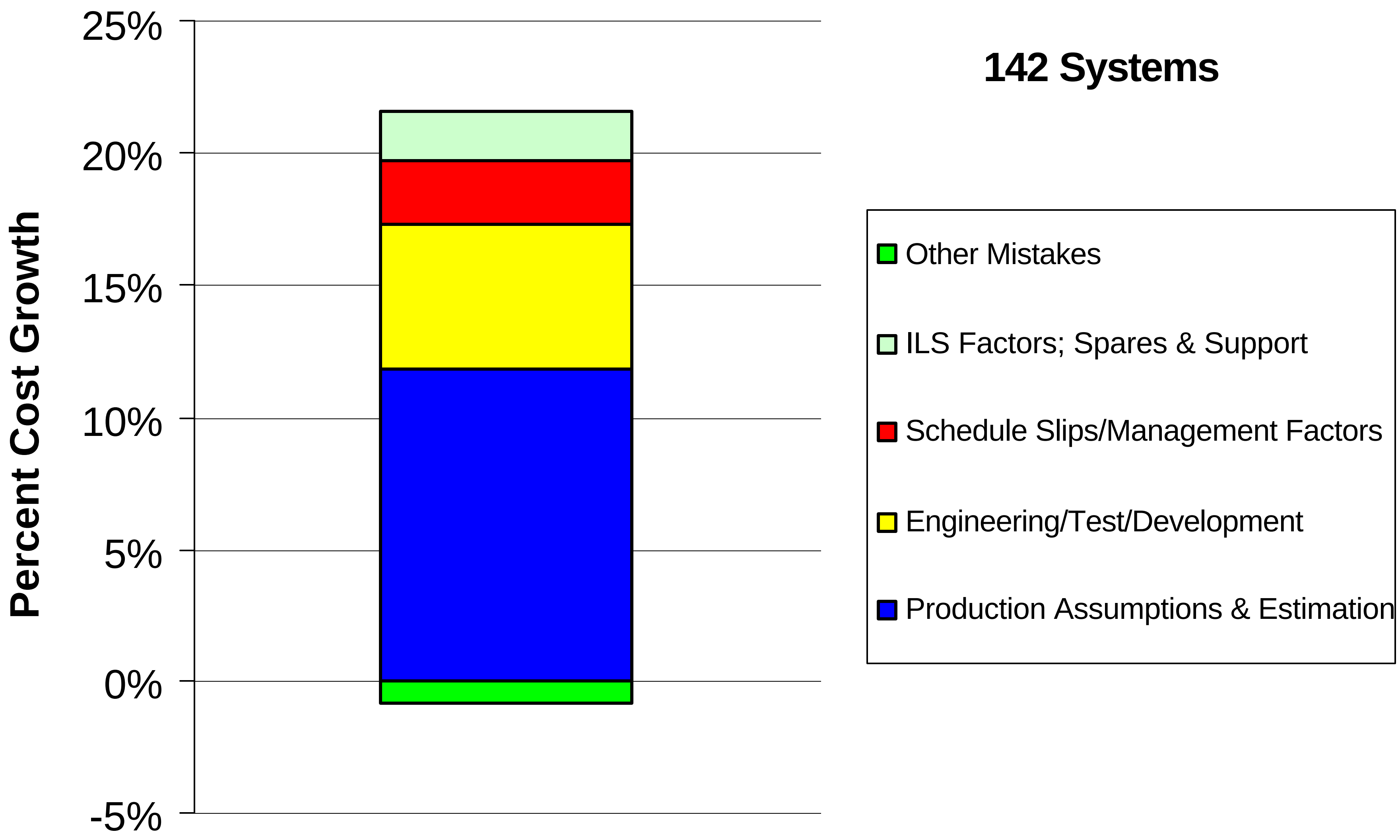


Total CG by Mistakes and Decisions

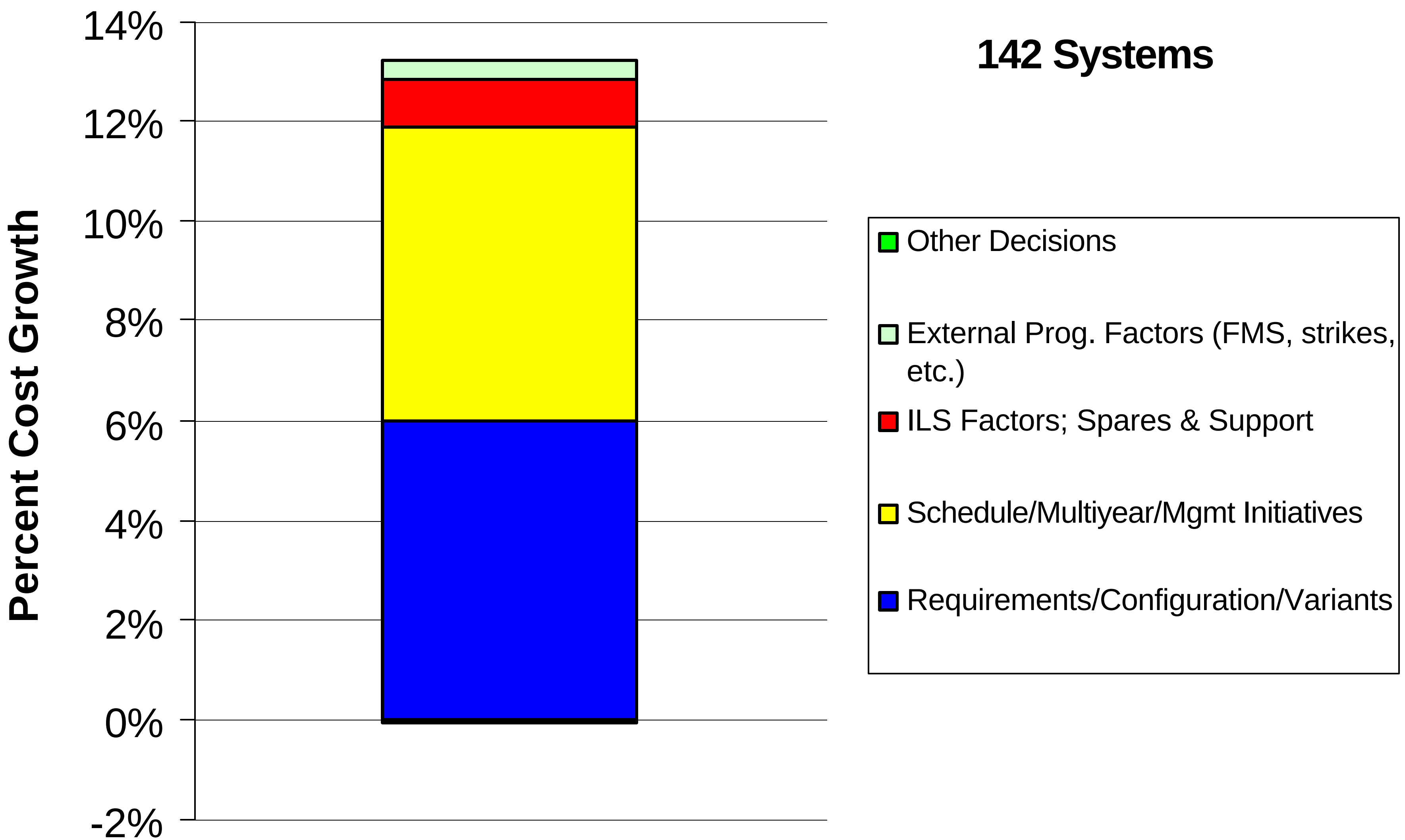
Nearly half of perceived growth is content change



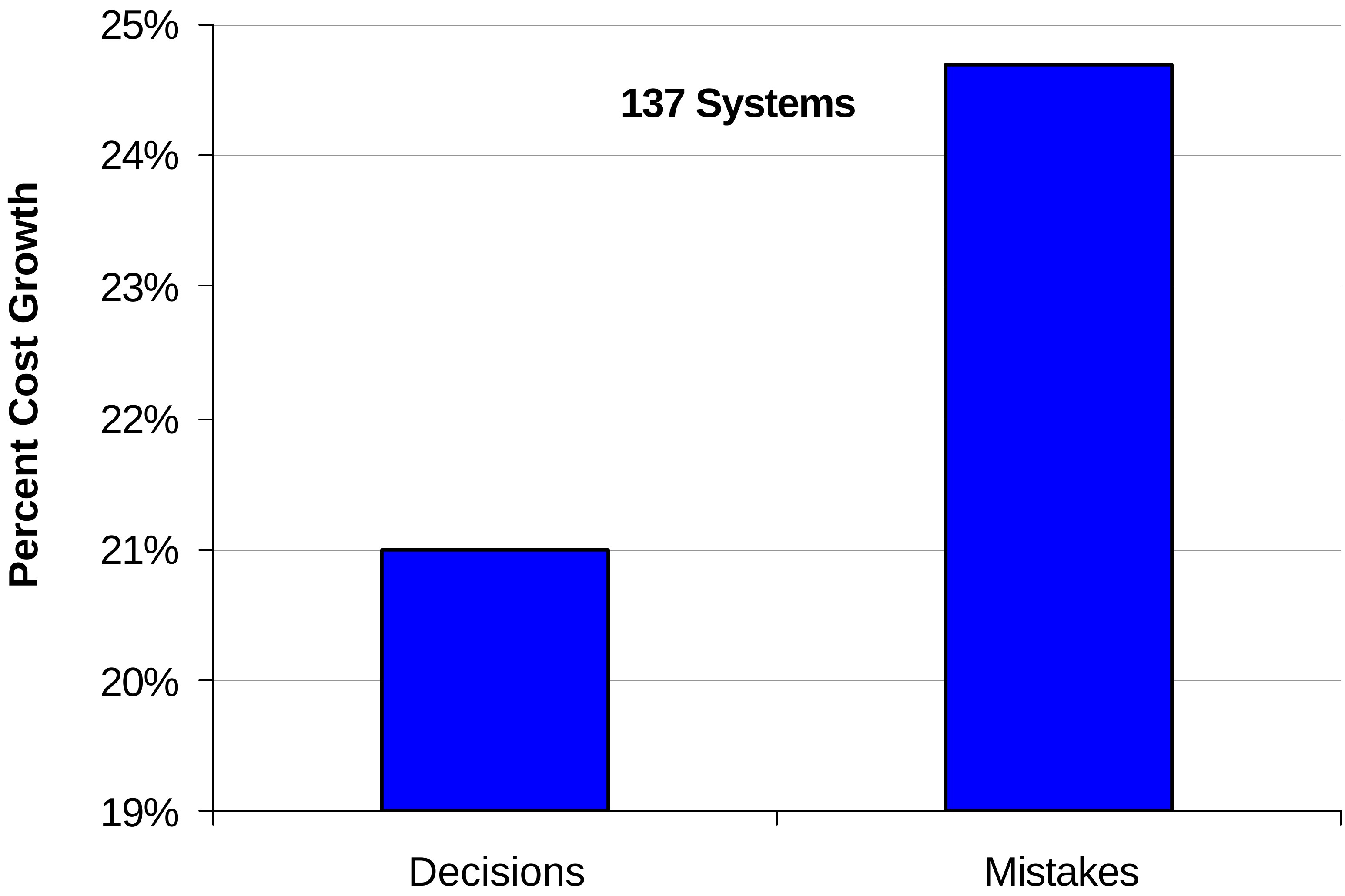
Total CG Mistakes



Total CG Decisions

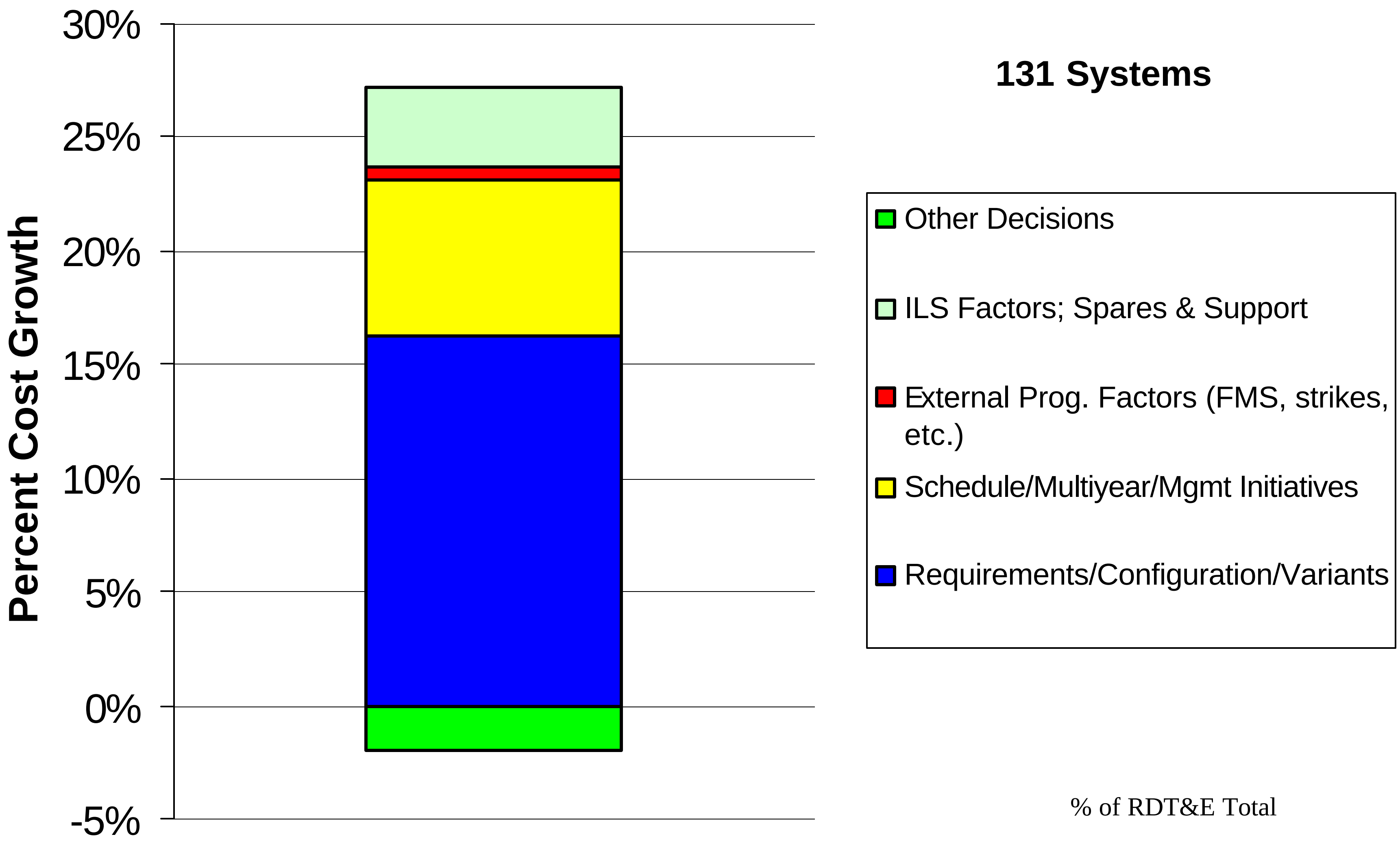


RDT&E Mistakes & Decisions



RDT&E Decision

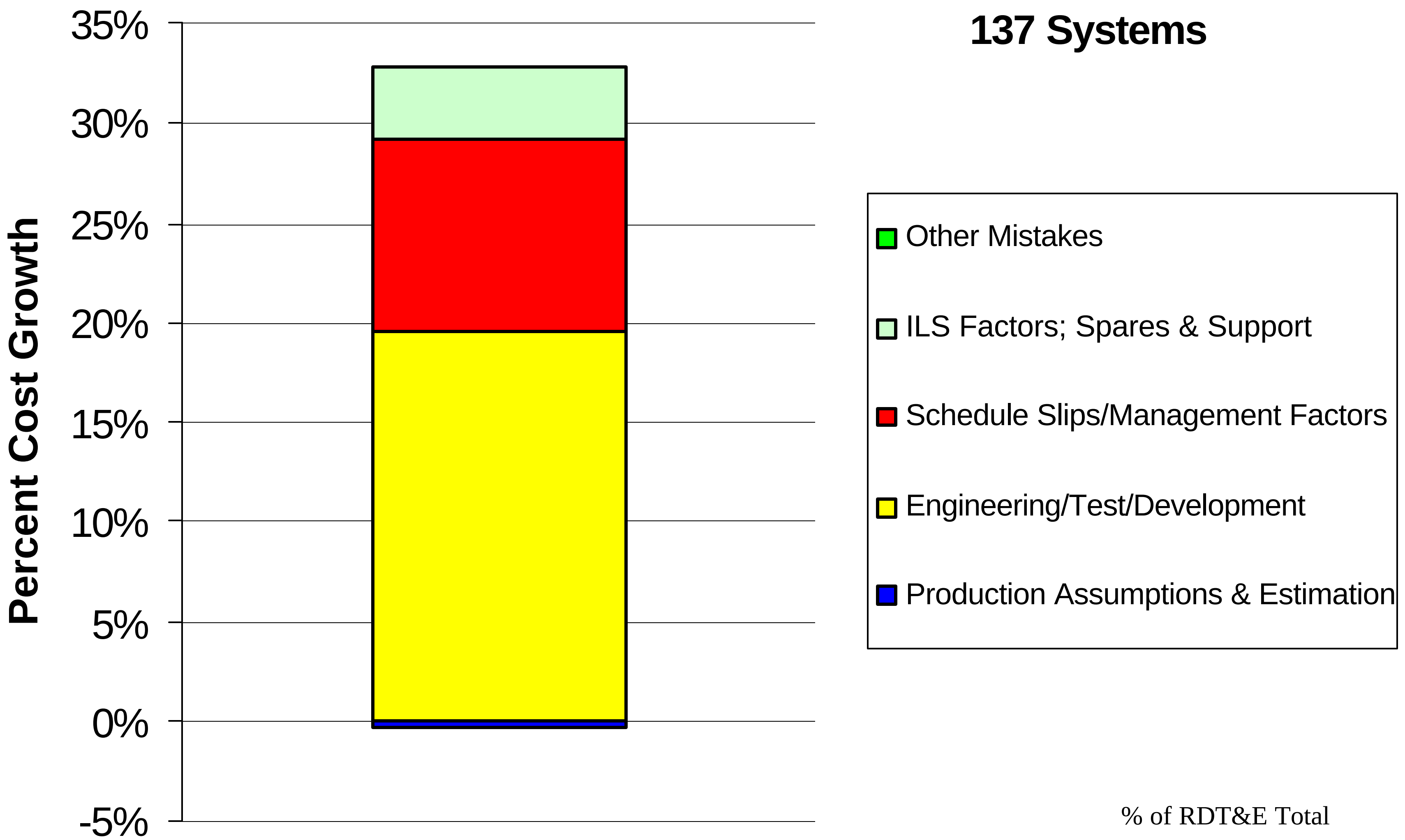
Requirements are the driver



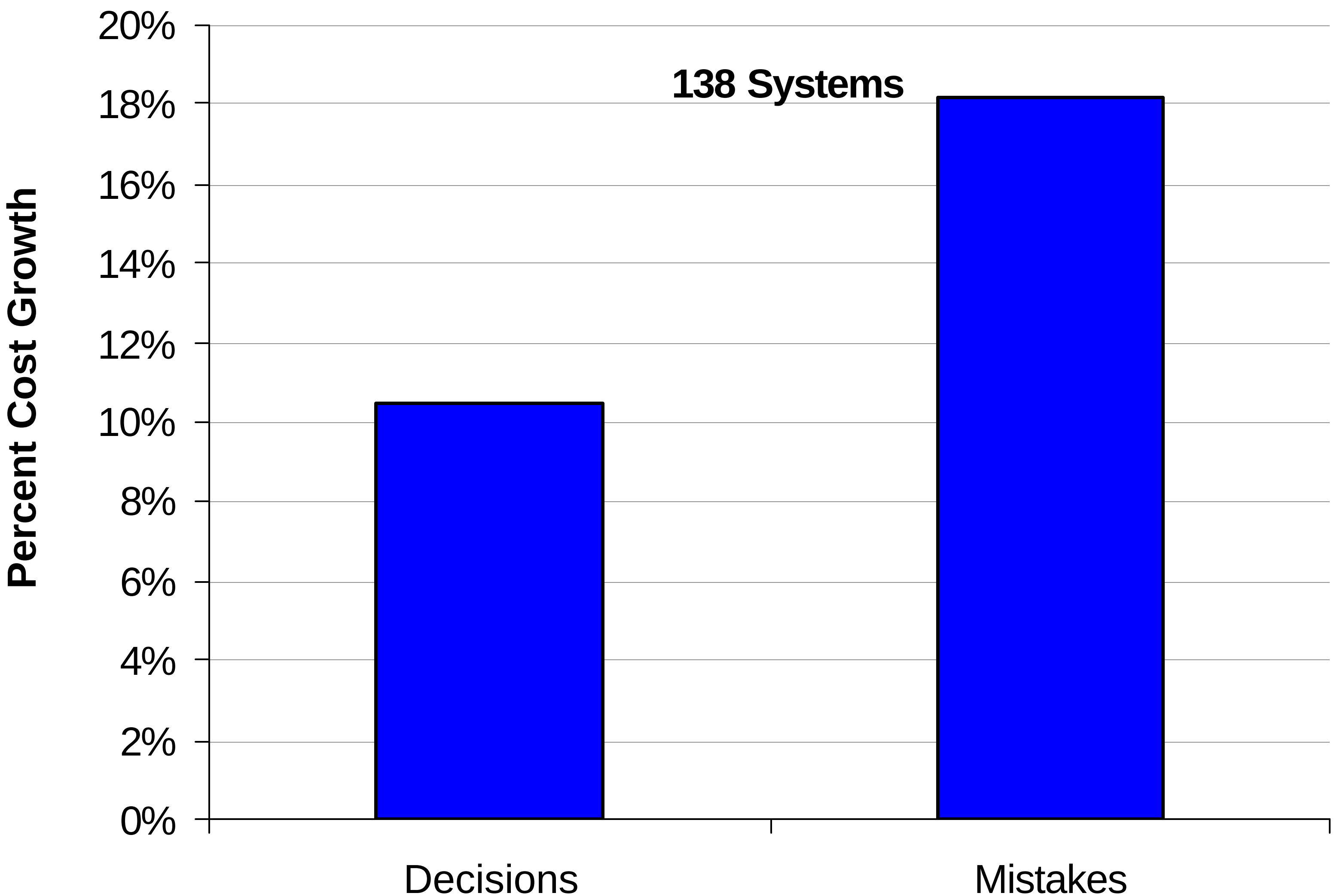
% of RDT&E Total

RDT&E Mistakes

Under estimating engineering effort is major source of error

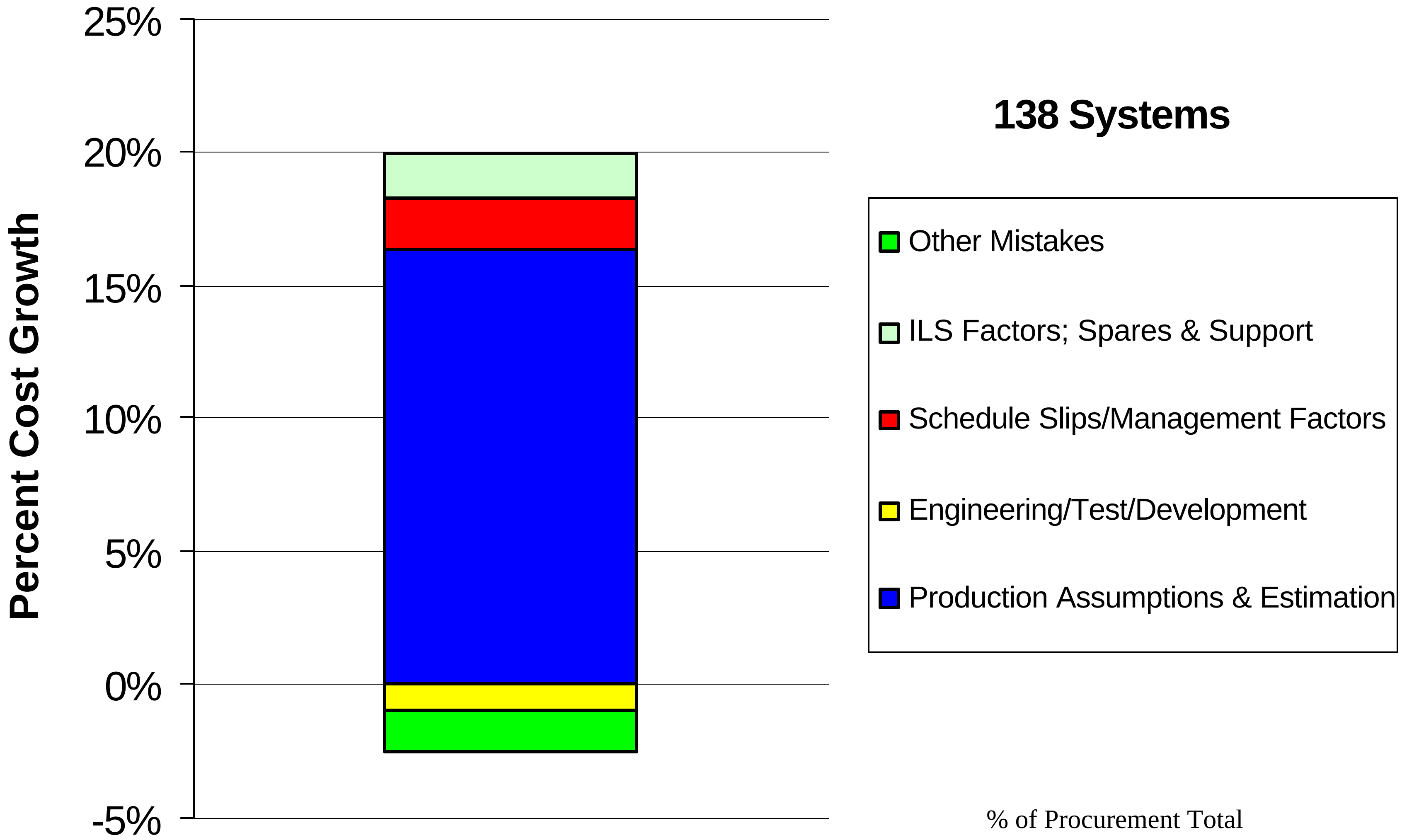


Procurement Mistakes & Decisions



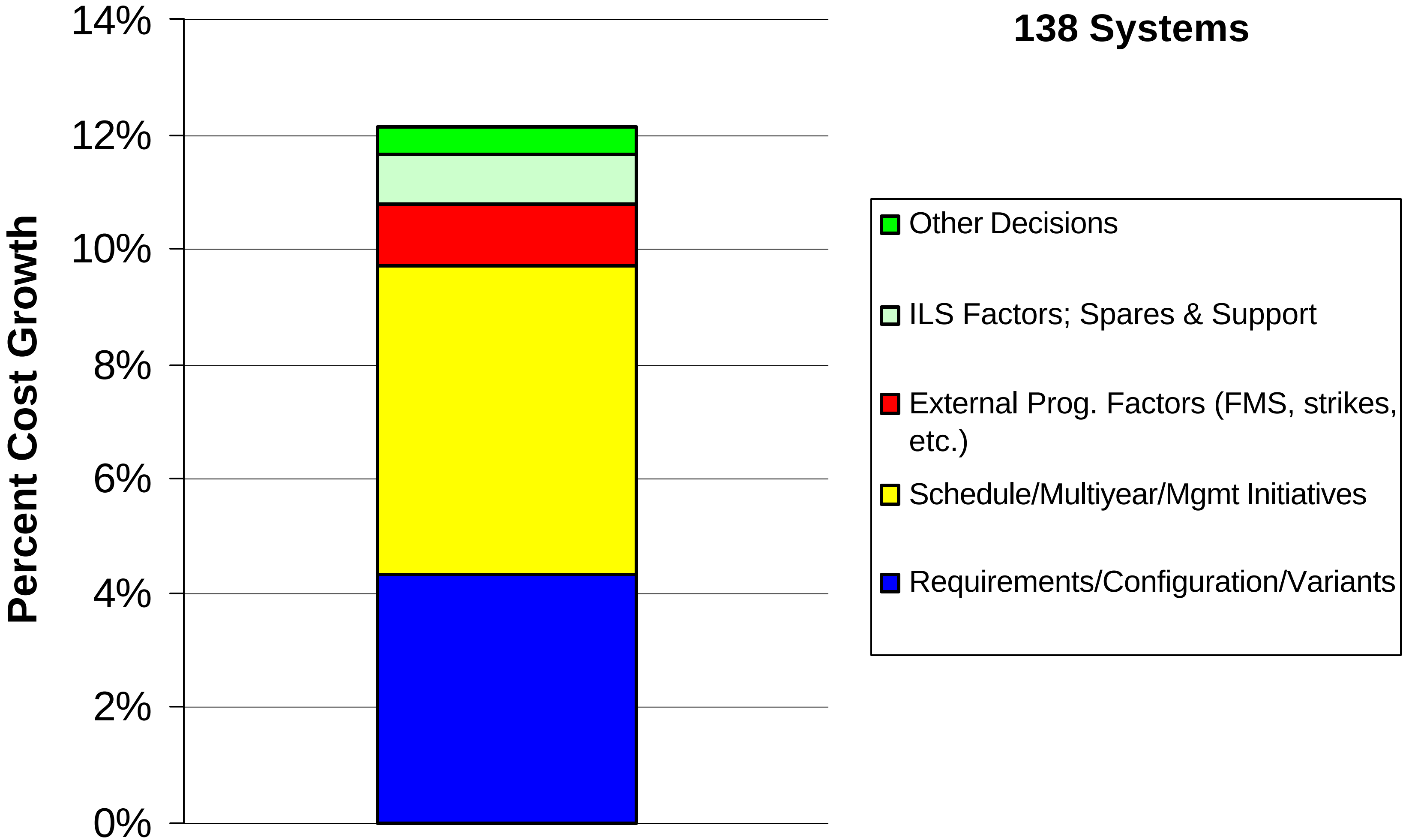
Procurement Mistakes

Major source of error is too optimistic learning curve for production assumptions



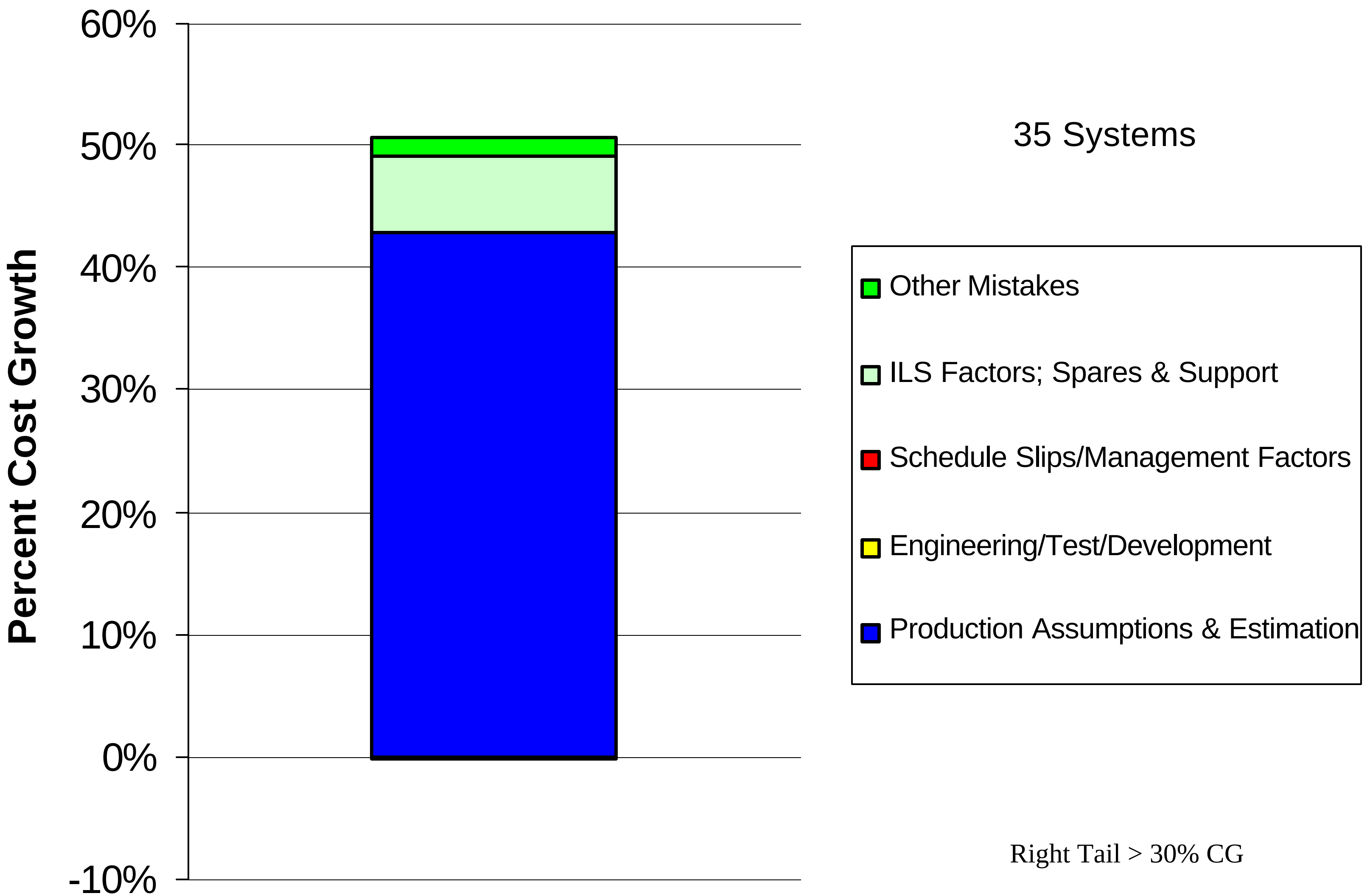
Procurement Decisions

Schedule and requirements changes cost

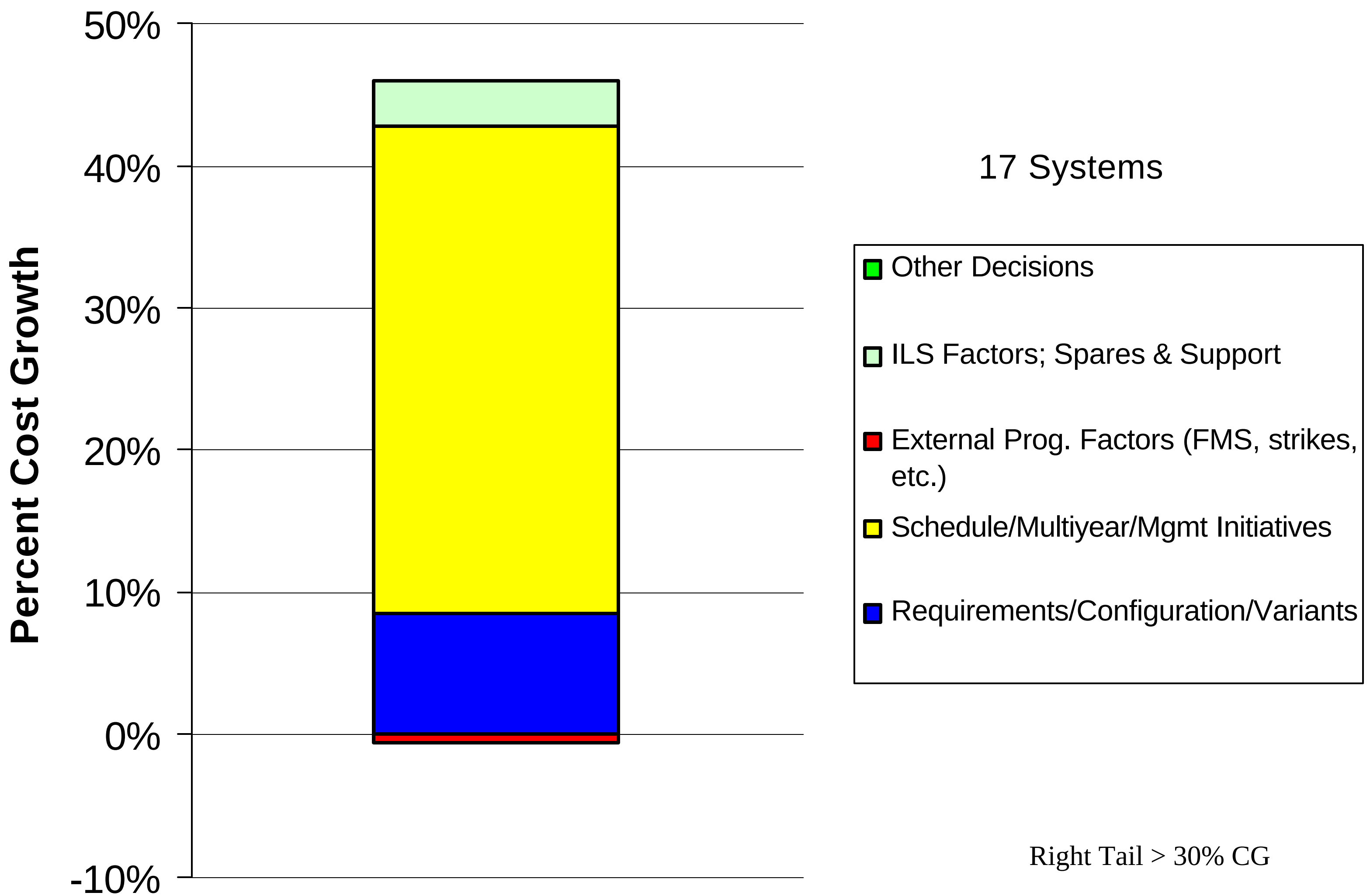


% of Procurement Total

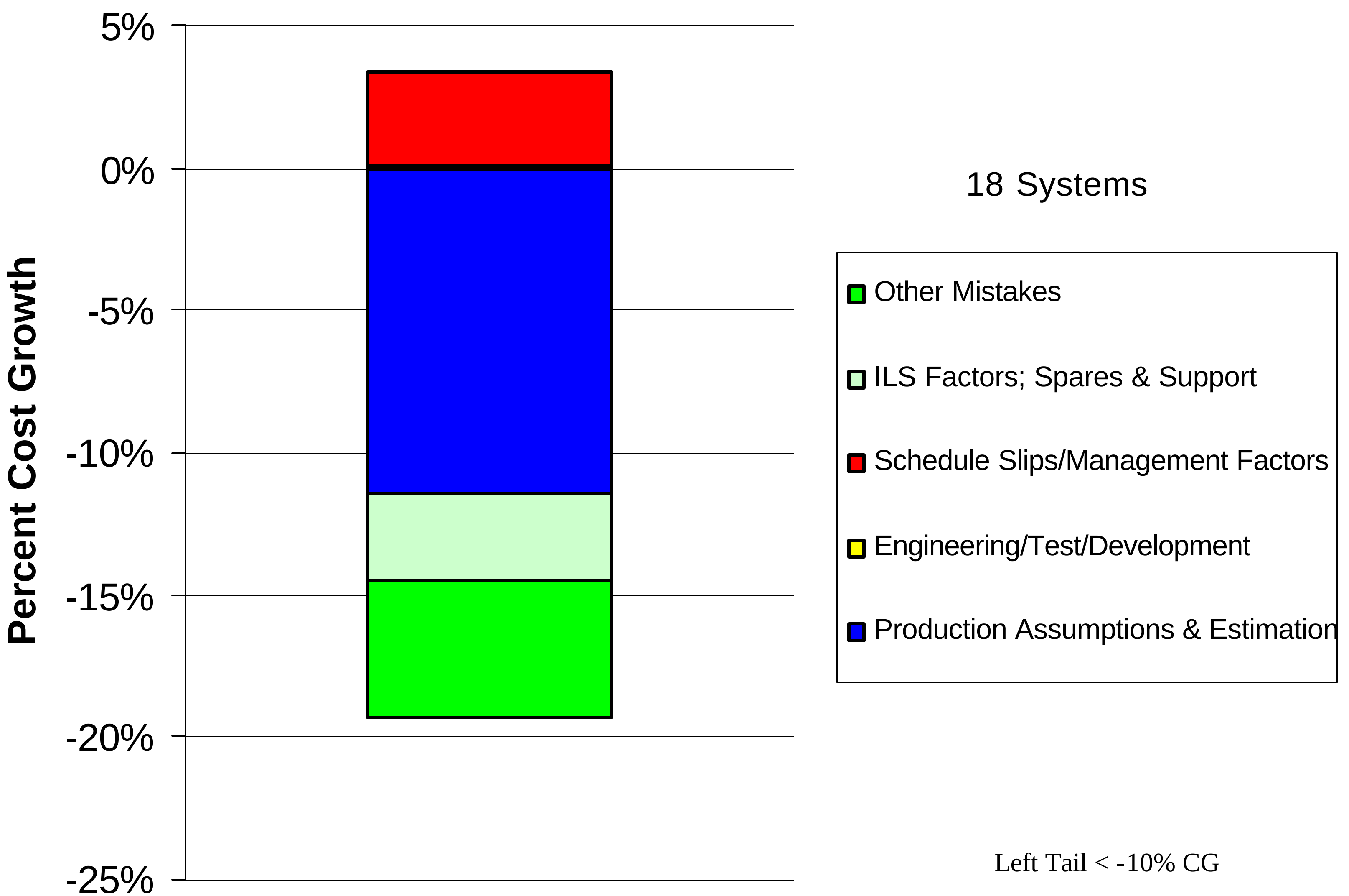
Procurement Mistakes
Right Tail



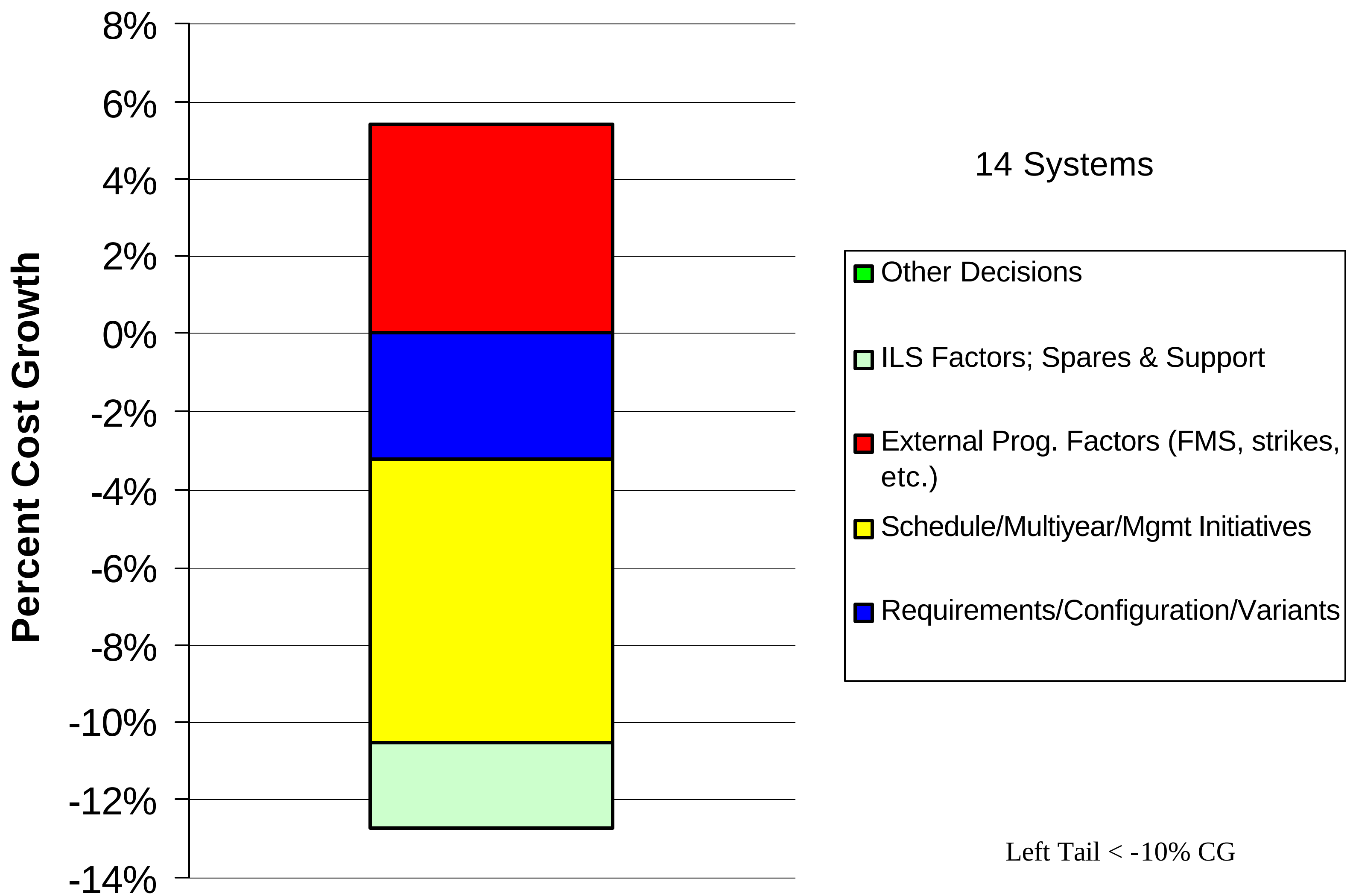
Procurement Decisions
Right Tail



Procurement Mistakes Left Tail



Procurement Decisions
Left Tail



Mistakes/Decisions Summary

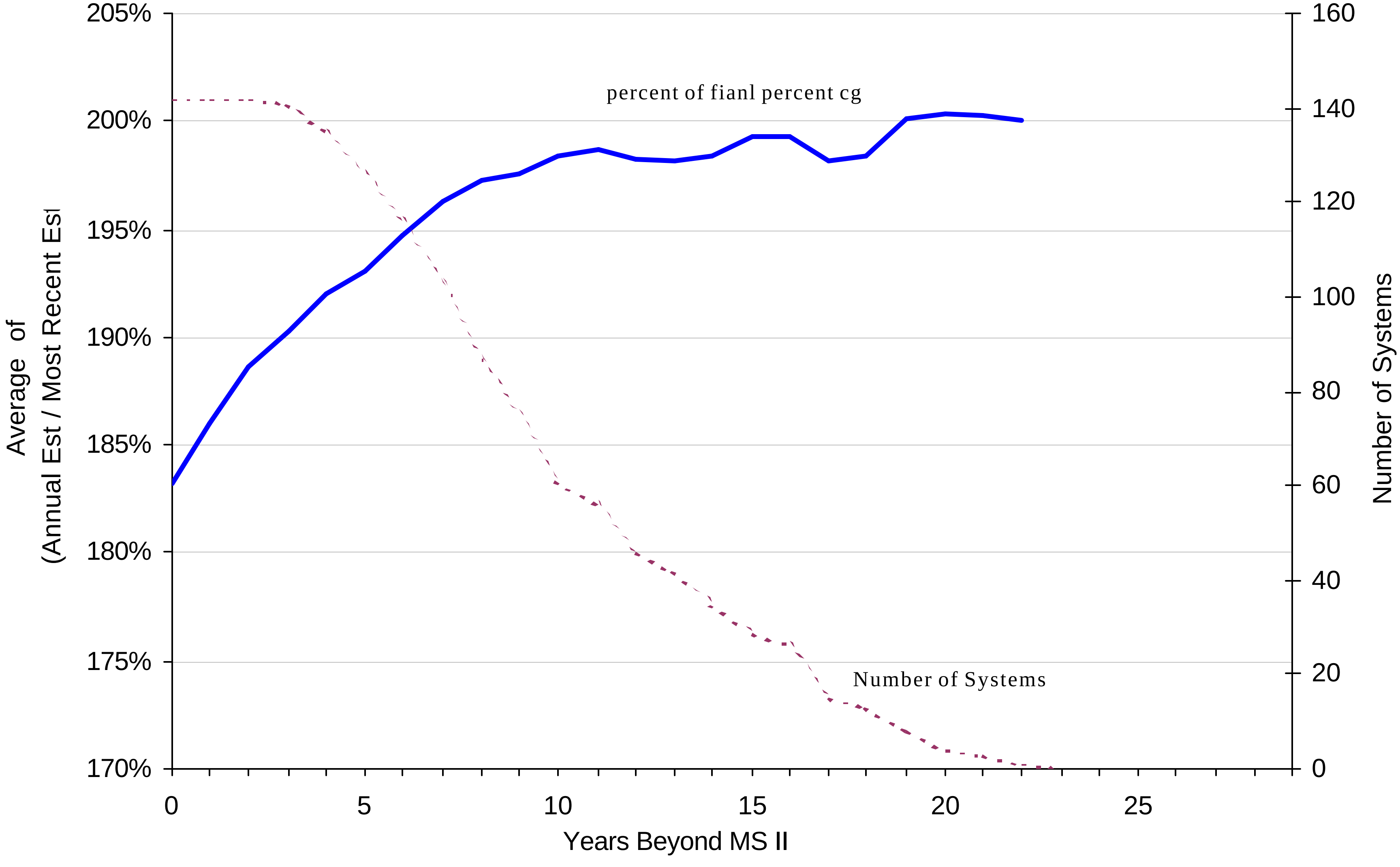
	Average Total CG = 32%									
	Mistakes = 20%					Decisions = 13%				
	MCEP	MCEDE	MILS	MSSMF	MOTHER	DRCV	DSMMI	DILS	DEPF	DOTHER
All	12%	6%	2%	2%	-1%	6%	6%	1%	-	-
R. Tail	42%	15%	7%	2%	2%	19%	41%	3%	-	-
L. Tail	-18%	-	-	3%	-6%	-2%	-13%	-2%	-	-

	Average RDT&E CG = 45%									
	Mistakes = 25%					Decisions = 21%				
	MCEP	MCEDE	MILS	MSSMF	MOTHER	DRCV	DSMMI	DILS	DEPF	DOTHER
All	-	20%	4%	10%	-	16%	7%	3%	1%	-2%
R. Tail	-	16%	1%	4%	1%	9%	11%	1%	1%	-
L. Tail	-	-2%	-	-	1%	-2%	-6%	-	-	-

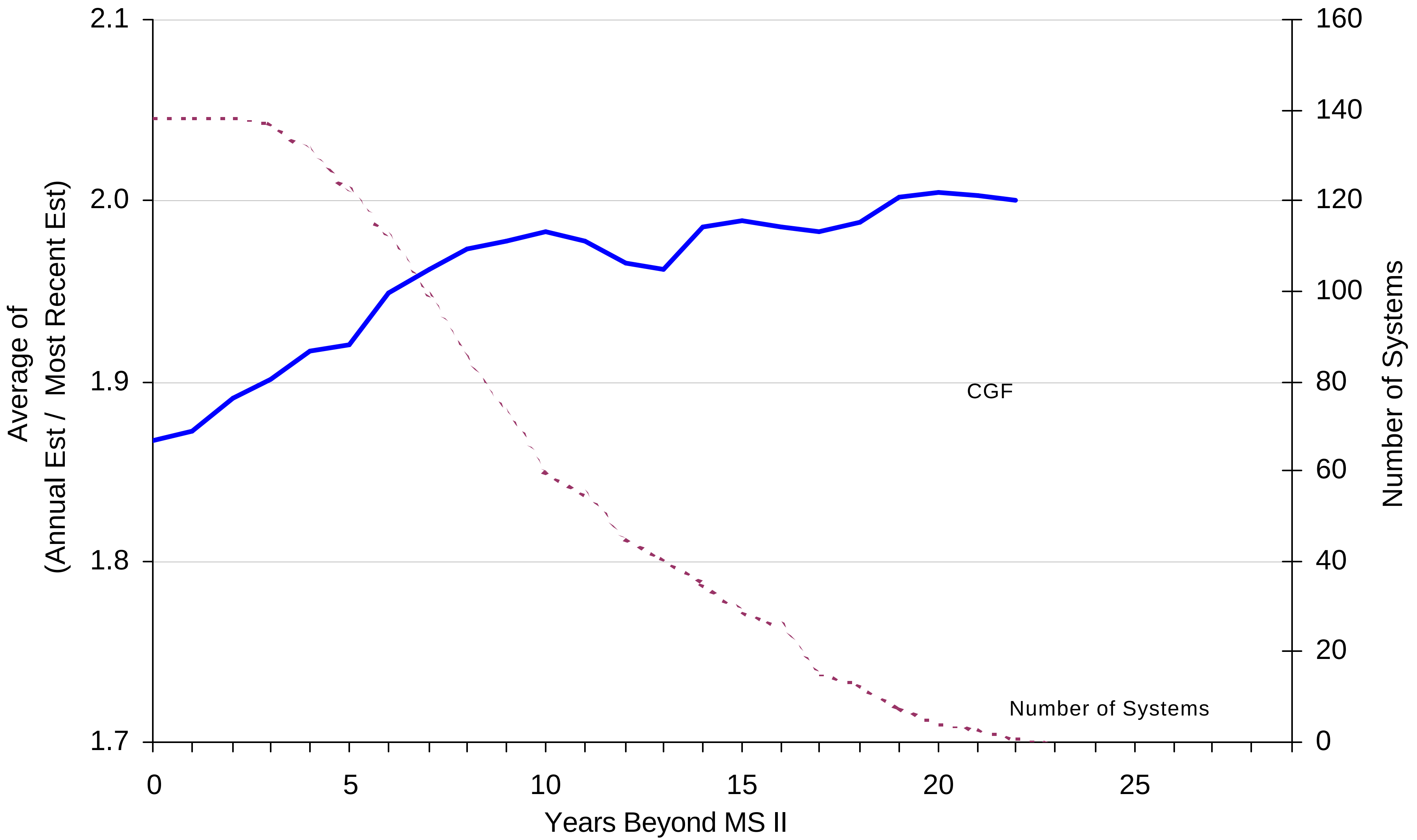
RDT&E accounts for 18% of the total resources

	Average Procurement CG = 29%									
	Mistakes = 18%					Decisions = 10%				
	MCEP	MCEDE	MILS	MSSMF	MOTHER	DRCV	DSMMI	DILS	DEPF	DOTHER
All	16%	-1%	2%	2%	-2%	4%	5%	1%	1%	-
R. Tail	43%	-	6%	-	1%	9%	34%	3%	-	-
L. Tail	-11%	-	3%	3%	-5%	-3%	-7%	-2%	5%	-

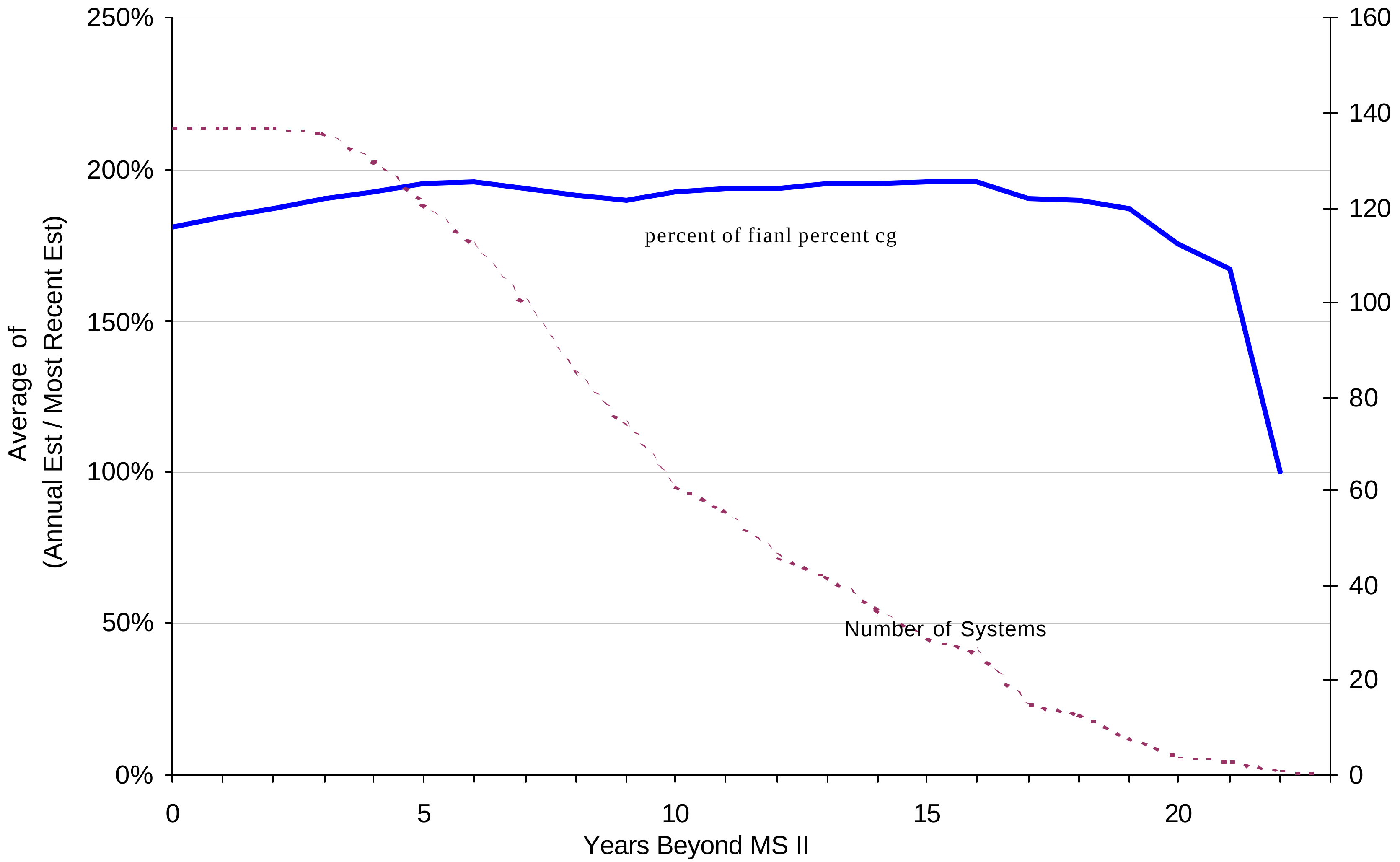
When Is Total CG Realized?



When is Procurement CG Realized?



When is RDT&E CG Realized?



Results Conclusions

- Cost growth appears to have a correlation with commodity
- Cost estimating assumptions account for majority of mistakes cost growth
  - Poor definition, poor estimates, nose under the tent pressures, unrealistic optimism
- Under estimating engineering effort is major source of RDT&E growth
- Nearly half of perceived cost growth is content change (i.e. decisions)
- Procurement CG is primarily due to optimistic learning curves
- Majority of systems do not have significant growth
- Higher cost systems appear to have less growth

Causes

- Poor cost data
- Poor techniques or wrong metrics
- Technical assumptions
- Camel’s nose under the tent (budget strategy)
- Contractor churn (profit)
- Wants vs. needs (requirements)
- Cost to budget
- Weak management (can’t say no)
- Schedule changes
- Unnecessary products, rabbit trails

Website

- View and download raw SAR data and adjusted SAR variances
- View and download summary charts
- Create, view, and download charts of user selected programs
- Password protected
  - User account required

- Not yet available, pending policy approval

MDAP Cost Growth - Microsoft Internet Explorer

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- Program Charts
- Chart Matrix

Welcome to the PA&E Cost Growth web site

Introduction This site publishes the Cost Analysis Improvement Group (CAIG) Cost Growth (CG) study for Major Defense Acquisition Programs (MDAPs). The purpose of this study is to quantify the magnitude of MDAP cost growth and classify its sources, identifying trends and relationships as appropriate. The CAIG sponsors this site under the direction of Dr. David McNicol. This site provides access to CG source data, summary data, and analysis charts.

Overview Cost growth is defined as any cost variance from a baseline position not attributable to inflation or quantity changes. Quantity changes are limited to the effects of learning curve caused by quantity changes. The study was conducted on MDAPs with more than three years of cost data past Milestone (MS) II. MS II is the base year for all results. All cost are shown in constant year 2000 dollars and are categorized into either "mistakes" or "decisions".

Inflation Normalization For this study all cost are converted to constant year 2000 dollars using DoD deflators for appropriation type (RDT&E, Procurement, ...) and commodity class (Ship, aircraft, ...) using the following equation:

FY00 $ = FY$/deflator

Quantity Normalization For this study we normalized the data to account for the effects of learning curve with quantity variation. As the quantity increases we would expect the unit cost to decrease. Similarly, we would expect unit cost to increase with a decrease in quantity. This study normalizes quantity changes with the following equation:

$$NV = V\left[\frac{(Q_0 + Q_{rd})^{(b+1)} - Q_{rd}^{(b+1)}}{(Q_c + Q_{rd})^{(b+1)} - Q_{rd}^{(b+1)}}\right]$$

where,

V = unadjusted variance

NV = quantity adjusted variance

Q_0 = baseline procurement quantity

Q_{rd} = RDT&E quantity

Q_c = current procurement quantity

b = learning curve constant

Done Local intranet

Start DoD... 29°Arlin... Inbo... Dolla... Com... CG - ... Win... Stati... MD... 29° 12:27 PM

MDAP Cost Growth - Microsoft Internet Explorer

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MDAP Cost Growth

Home

Program Charts

Chart Matrix

Program Charts

Commodity Service All Search

De-select the MDAPs you aren't interested in, and click Go to view data.

All	MDAP Name *Summary Chart*	PNO	Service	Commodity	SubCommodity	Latest SAR
☑	Sort -	-	-	-	-	-
☑	A-10 Thunderbolt	503	Air Force	Aircraft	Tactical	1982
☑	A-6E/F Intruder	504	Navy	Aircraft	Tactical	1988
☑	ADDS EPLRS (Enhanced Pst Location Rpt Sys)	5	Army	C4I	Command and Control	1994
☑	AEGIS MK-7	6	Navy	C4I	Command and Control	1979
☑	AFATDS (Adv Field Artilleray Tact Data Sys)	7	Army	C4I	Command and Control	1998
☑	AGM-114 Hellfire	509	Army	Missile	ATG	1993
☑	AGM-114K Hellfire Longbow	528	Army	Missile	ATG	2001
☑	AGM-131A SRAM II (Short Range Msl)	562	Air Force	Missile	ATG	1991
☑	AGM-65D Maverick IR	8	Air Force	Missile	ATG	1992
☑	AGM-84A Harpoon	508	Navy	Missile	ATG	1991
☑	AGM-86B ALCM	14	Air Force	Missile	Cruise	1985
☑	AGM-88 HARM USAF	506	Air Force	Missile	ATG	1986
☑	AGM-88 HARM USN	507	Navy	Missile	ATG	1994
☑	AH-64 Apache	9	Army	Aircraft	Helicopter	1992
☑	AH-64D Apache Airframe	527	Army	Aircraft	Helicopter	2001
☑	AH-64D Apache FCR	526	Army	Aircraft	System	2001

Local intranet

Start DoD... 29°:Arlin... Inbo... Dolla... Com... CG - ... Win... Stati... MD... Micr... 29° 12:28 PM

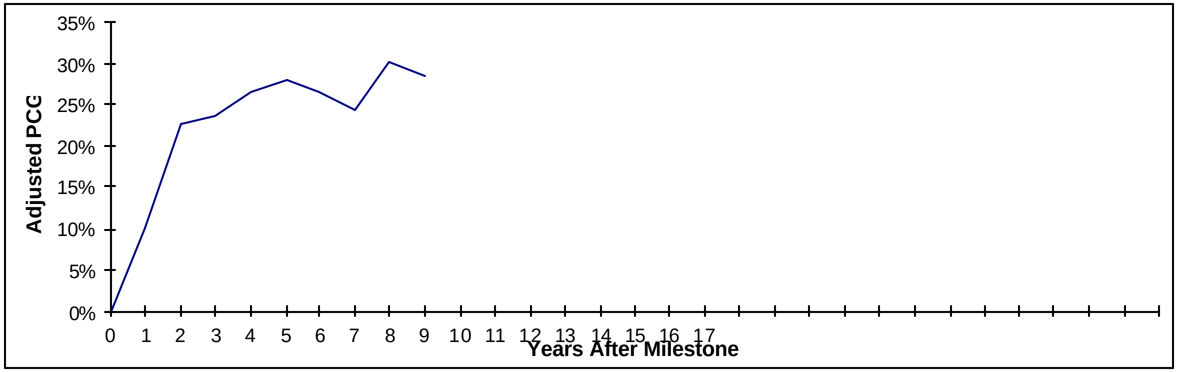
System	A-10 Thunderbolt
Most Recent SAR Year	1982
Baseline Year	1973

Current Estimate	9,813.3
Current Est. Qty. Adusted to Baseline	9,507.9
Baseline Estimate	7,405.2
Adjusted Total Variance	2,102.7
Adjusted Percent Cost Growth (PCG)	28.4%

	RDTE PCG	PROC PCG	MilCon PCG	Total PCG
MISTAKES	14.9%	8.8%	0.0%	9.9%
Cost Estimating (Production)	0.0%	7.4%		6.1%
Cost Estimating (Develop./Engrg)	14.7%	0.0%		2.5%
ILS Factors, Spares & Support	2.0%	10.3%		8.9%
Schedule Slips/Management Factors	1.0%	2.1%		1.9%
Escalation Requirements	-4.3%	-6.3%		-6.0%
Other Mistakes	1.5%	-4.7%		-3.6%
DECISIONS	3.8%	21.6%	0.0%	18.5%
Requirements/Configuration/Variants	1.5%	4.3%		3.8%
Schedule/Multiyear/Mngt. Initiatives	2.4%	17.6%		15.0%
ILS Factors, Spares & Support	0.0%	-0.3%		-0.2%
External Prog. Factors (FMS, strikes, etc.)				
Other Decisions				

SAR Pubctn Year	Appropriation	Explanation	SAR Cat.	M_D Cat.	QTY Adj Var
1975	PROC	Program Stretchout	Schedule	dsmmi	1148.9
1974	PROC	Addition of simulators	Support	mils	357.3
1975	PROC	Adjustment (December 1974 and March 1975 SARs are internally inconsistent)	Other	mother	-272.5
1974	PROC	Additional avionics	Engineering	mcep	266.5
1979	PROC	Adjustment for prior year escalation.	Estimating	mescl	-225.7
1981	PROC	Increased Cost due to lower Production rate	Schedule	mssmf	184.7
1979	PROC	Additional ground support equipment, simulator, other training equipment and data.	Support	mils	151.4
1976	PROC	Add Avionics	Engineering	mcep	147.3
1977	PROC	Add inertial navigation system.	Engineering	drcv	135.1
1975	RDTE	Follow-on Development effort	Engineering	mcede	126.7
1977	PROC	Estimating baseline adjustments.	Estimating	mcep	121.3
1982	PROC	Adjustment for prior year escalation.	Estimating	mescl	-112.6
1981	PROC	Reestimate of initial spares	Support	mils	106.2
1980	PROC	Delete Outyear Simulators	Support	dils	-104.0
1974	PROC	Transfer of four RDTE aircraft to procurement account.	Quantity	drcv	79.1
Total			*****	*****	2109.8

Comment



MDAP Cost Growth

Chart Matrix

MDAP Cost Growth Chart Matrix
Click on the ● to see the chart.

Title	Type	RDT&E Mistakes	RDT&E Decisions	RDT&E M&D	RDT&E M&D Summed	Proc Mistakes	Proc Decisions	Proc M&D	Proc M&D Summed	RDT&E & Proc Separate Mistakes	RDT&E & Proc Separate Decisions	RDT&E & Proc Separate M&D	RDT&E & Proc Separate M&D Summed	RDT&E & Proc Summed Mistakes	RDT&E & Proc Summed Decisions	RDT&E & Proc Summed M&D	RDT&E & Proc Summed M&D Summed
%CG vs. Commodity Class	**Multi-Bar**																
Army				●	●			●	●			●	●	●	●	●	●
Navy		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Air Force		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Joint		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
All (Summed)		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
All (Individually)		●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
# Systems vs. %CG ranges	**Histogram**	●	●		●	●	●		●					●	●		●
Army		●	●		●	●	●		●					●	●		●
Navy		●	●		●	●	●		●					●	●		●
Air Force		●	●		●	●	●		●					●	●		●
Joint		●	●		●	●	●		●					●	●		
All (Summed)		●	●		●	●	●		●					●	●		
All (Individually)		●	●		●	●	●		●					●	●		
% Procurement CG vs. % RDT&E CG	**Correlation**																
Aircraft																	
Electronic																	
Helicopter																	
Missile																	

MDAP Cost Growth - Microsoft Internet Explorer

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MDAP Cost Growth

Home

Program Charts

Chart Matrix

Program Downloads and Charts

You chose the following program(s)....

```
A-10 Thunderbolt
AGM-131A SRAM II (Short Range Msl)
AGM-65D Maverick IR
AGM-86B ALCM
```

Option #1: Select New Program(s)

Click here to return to the program search screen.

Option #2: Summary Download

Select download type and press "download":

- (•) Cost Growth Factors
- ( ) Program Base Data

[download..]

Option #3: View Program(s) In A Chart

Select a chart from the matrix below. Charts contain data only for selected programs.

Click on the ● to see the chart.

Title	Type	RDT&E Mistakes	RDT&E Decisions	RDT&E M&D	RDT&E M&D Summed	Proc Mistakes	Proc Decisions	Proc M&D	Proc M&D Summed	RDT&E & Proc Separate Mistakes	RDT&E & Proc Separate Decisions	RDT&E & Proc Separate M&D	RDT&E & Proc Separate M&D Summed	RDT&E & Proc Summed Mistakes	RDT&E & Proc Summed Decisions	RDT&E & Proc Summed M&D	RDT&E & Proc Summed M&D Summed
%CG vs. Commodity Class	Multi-Bar	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
# Systems vs. %CG ranges	Histogram	●	●		●	●	●		●					●	●		●
%CG ranges vs. # Systems	Histogram																
%CG vs. Growth Category	Bar	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
%CG vs. Growth Sub Categories	Bar	●	●		●	●	●		●					●	●		●

Done Local intranet

Start DoD... 29°:Arlin... Inbo... Dolla... Com... CG - ... Win... Stati... MD... Micr... 12:29 PM

Data Access

- Access policy not established
  - 2-4 months
- Anticipate it will be available to those working in the cost community
  - Those doing their own research
  - Combining results with other studies
  - Access will probably be provided on a case by case basis
- Don’t want to see our data in the newspaper with our name on it, “OSD PA&E says …”

Future

- Website access (2-4 months)
- Ability to select different milestones (~4-months)
- Ability to select different base year (~4-months)
- Documentation (~6 months)
  - This is all we have at the moment
- 2002 SARs and beyond (~6 months)
- Add SAR source data links
- Production rate change research

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