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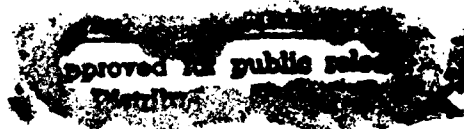
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Cost Growth in DoD Major Programs: A Historical Perspective

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ABSTRACT

Cost growth in major weapon systems has been an enduring problem in the Department of Defense (DoD) for the last three decades. This research project provides a historical perspective of that problem based on a review of thirty-three cost growth reports, articles, and studies published between 1965 and 1992. It examines cost growth both from the congressional perspective and the DoD perspective. Over the years, many qualitative assessments of the factors that cause cost growth have been identified. DoD has acted on these findings and implemented numerous initiatives aimed at combating cost growth. Although DoD has had some limited success, cost growth is still a significant problem. General Accounting Office (GAO) reports indicate the average cost growth in major DoD acquisition programs is 40-50% when compared to the initial planning estimate made during Concept Exploration and Development. When compared to the development estimate made before Engineering and Manufacturing Development, the average cost growth is 20-30%. Both RAND and the Institute for Defense Analysis (IDA) have completed numerous cost growth studies for DoD. These reports have attempted to quantify the factors that cause cost growth during the Engineering and Manufacturing Development phase of the acquisition cycle. Like the GAO results, they report average cost growths from 20-50%. The report provides four recommendations for DoD to implement in its battle with cost growth.

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ABSTRACT

Cost growth in major weapon systems has been an enduring problem in the Department of Defense (DoD) for the last three decades. This research project provides a historical perspective of that problem based on a review of thirty-three cost growth reports, articles, and studies published between 1965 and 1992. It examines cost growth both from the congressional perspective and the DoD perspective. Over the years, many qualitative assessments of the factors that cause cost growth have been identified. DoD has acted on these findings and implemented numerous initiatives aimed at combating cost growth. Although DoD has had some limited success, cost growth is still a significant problem. General Accounting Office (GAO) reports indicate the average cost growth in major DoD acquisition programs is 40-50% when compared to the initial planning estimate made during Concept Exploration and Development. When compared to the development estimate made before Engineering and Manufacturing Development, the average cost growth is 20-30%. Both RAND and the Institute for Defense Analysis (IDA) have completed numerous cost growth studies for DoD. These reports have attempted to quantify the factors that cause cost growth during the Engineering and Manufacturing Development phase of the acquisition cycle. Like the GAO results, they report average cost growths from 20-50%. The report provides four recommendations for DoD to implement in its battle with cost growth.

BIOGRAPHY

Colonel Calcutt is a student at the Industrial College of the Armed Forces. The first half of his career was spent in operations as an electronic warfare officer and navigator. For the last ten years, he has worked in the acquisition career field with assignments at the Air Staff, HQ Air Force Systems Command, and the Air Force Electronic Combat Office. He is a 1972 graduate of the United States Air Force Academy with a B.S. in Electrical Engineering. Colonel Calcutt also has a M.S. in Industrial Engineering with a specialty in Operations Research from the University of Illinois. He is a graduate of the Air Command and Staff College and the Defense Systems Management College.

INTRODUCTION

Claire Brown observed that prior to World War II, "virtually no government agency had to account for its costs or budgets" (11). However, in the last fifty years Congress and the Department of Defense (DoD) have taken considerable steps to institute consistent accounting standards in reporting by defense contractors and to review cost estimates for weapon systems at each stage of development (Brown 11). This change in philosophy revealed that many programs experienced significant cost increases over their original estimates. In 1982, an unnamed witness at a House Armed Services Committee (HASC) meeting stated, "Enough material has been written on the subject of cost growth during the last ten years to fill a Minuteman silo¹. Unfortunately, cost growth is still with us..." (United States 25). In the decade since that testimony, enough additional information on cost growth has been written to fill a second Minuteman silo. Although DoD has implemented many initiatives, it's still grappling with the problem of cost growth. Based on a review of thirty-three cost growth reports, articles, and studies published between 1965 and 1992, this report provides a top-level assessment of the cost growth issue in DoD major acquisition programs. It focuses on the following aspects of cost growth:

¹ A Minuteman silo is approximately 10 ft. wide and 70 ft. deep.

- * How is cost growth defined?
- * What is the magnitude of cost growth?
- * What factors cause cost growth?
- * What attempts have been made to control cost growth?
- * What success has DoD achieved in controlling cost growth?
- * What are the implications of cost growth in today's environment?
- * What steps can be taken to combat cost growth?

HOW IS COST GROWTH DEFINED?

The term "cost growth" is used in a variety of contexts. Some use it to refer to the differences in price between weapons developed in the past versus the soaring costs of weapons being developed today. The ultimate extrapolation of this concept is Augustine's Law Number IX, which states, "By the year 2054, the entire defense budget will purchase just one tactical aircraft" (Augustine 48). This report doesn't examine that aspect of cost growth. Rather, it focuses on the change between an estimate of program cost versus the actual program cost. Even within that context, there are several variations on the use of the term "cost growth." This section describes those variations of cost growth definition used by the key organizations that have studied this problem.

SELECTED ACQUISITION REPORT (SAR)

A key aspect of any discussion of cost growth is the SAR. Since 1969, Congress has required DoD to submit SARs on its major acquisition programs. SARs contain the information necessary to identify three cost estimates which are useful in analyzing program cost growth:

- * Planning Estimate. This is the DoD estimate normally made during the Concept Exploration and Definition (CED) phase of the acquisition cycle.
- * Development Estimate. This is the estimate established at Milestone II, which begins the Engineering and Manufacturing Development (EMD) phase--formerly Full Scale Development (FSD)--of the acquisition cycle.
- * Current Estimate. This is the most up-to-date estimate of what the program will cost at completion.

These estimates, which can be expressed in then-year dollars or current-year dollars, provide a good, top-level view of the changes in total program costs. However, the General Accounting Office (GAO) observed that these estimates don't "readily identify pure cost growth, i.e., increased costs in constant dollars for programs" (Theory and Practice 36). Instead, they reflect the cost changes due to a variety of factors, such as actual inflation versus projected inflation, cost estimating, quantity changes, etc.

In fact, the SAR has seven categories for identifying cost changes:

- * Economic
- * Quantity
- * Schedule
- * Engineering
- * Estimating
- * Other
- * Support

Many observers have noted that SAR data isn't perfect due to several factors. One is the interdependence between the various categories. For example, an engineering problem could result in a schedule slip as well as a change in support requirements. Where should the cost change be documented? A second factor is the inconsistencies associated with many program managers interpreting the guidelines for SAR reporting differently. Paul Hough documented these and other problems in a RAND report² in 1992. However, for all their shortcomings, SARs are the most convenient source of data for studying cost growth and are used by all organizations doing serious research in this area.

² Calculating Cost Growth from Selected Acquisition Reports. RAND, 1992.

TWO PERSPECTIVES ON THE DEFINITION OF COST GROWTH

A review of the published literature reveals four major groups interested in cost growth: Congress, DoD, special interest groups, and individuals. This report primarily focuses on the first two groups.

Congressional Perspective

In executing its constitutional responsibility to provide funds for defense, Congress has significantly increased its oversight of DoD programs in the last fifty years. The GAO has been Congress' primary agent for examining cost growth, but it has also relied on congressional hearings and the Congressional Budget Office (CBO) to examine some aspects of cost growth. The GAO reports program cost growth based on the estimates in the SARs; therefore, its cost growth figures have historically been based on three comparisons:

- * Planning Estimate versus Current Estimate
- * Development Estimate versus Current Estimate
- * Adjusted Estimate³ versus Current Estimate

Each of these comparisons can yield widely varying results on

³ The planning estimate or development estimate adjusted for changes in the original quantity requirement.

program cost growth. These comparisons provide Congress a top-level look at the impact of cost growth on the budget process. Past GAO reports have also compared the cost growth results between the services, types of programs, and the seven cost growth categories in the SAR. Based on these comparisons, the GAO has made qualitative assessments on the causes of cost growth and the effectiveness of DoD programs to reduce cost growth. However, its primary focus has been to report the magnitude of cost growth in DoD major acquisition programs.

DoD Perspective

The two primary organizations that have examined cost growth for DoD have been the RAND Corporation and the Institute for Defense Analysis (IDA). It's likely that numerous organizations within DoD itself have also examined cost growth. However, the results of these types of reviews usually aren't published and, therefore, are next to impossible to find.

In 1979, RAND researchers identified cost growth as a ratio between the Milestone II (development) estimate reported in the SAR and the current estimate in the SAR. They defined this term as the "cost growth function" (CGF). Programs experiencing cost growth will have a CGF greater than one. In determining the CGF, RAND used constant dollars and adjusted the estimates for both quantity

changes and inflation. Unlike the GAO, RAND doesn't normally compare current cost estimates to planning estimates made prior to Milestone II. It is more interested in examining "pure cost growth." It reports not only total program cost growth since Milestone II, but also its two components: development cost growth and production cost growth.

IDA has the same basic approach to studying cost growth as RAND and also uses the same CGF ratio. However, it would be a mistake to directly compare RAND and IDA results because there are several differences in their methodologies that impact their results.

A key point is RAND and IDA have a different objective in examining cost growth than the GAO. Their primary focus is to understand the factors that cause cost growth and to develop a formula that accounts for these factors. This formula would be used to adjust cost estimates to reflect a better estimate of the actual cost of a program. To achieve this objective, both RAND and IDA have accomplished some statistical analyses to obtain quantitative explanations of cost growth factors versus purely qualitative observations.

FINAL THOUGHTS ON THE DEFINITION

So what is the "real" definition of cost growth? The answer is "it

all depends on your purpose." The GAO's primary purpose is to provide Congress a top-level assessment of DoD's ability to plan and manage acquisition programs. More often than not, it will express cost growth as a comparison of the planning estimate to the current estimate. This comparison normally yields the worst results and fails to reflect conscious decisions by either DoD or Congress to change the scope of a program. On the other hand, RAND and IDA's purpose is to provide DoD insight into the factors--other than conscious decisions to change the scope of a program--that cause cost growth. Therefore, they chose a definition that allows them to make "an apples-to-apples" comparison of cost estimates. The bottom line is be wary of how the term "cost growth" is being used.

WHAT IS THE MAGNITUDE OF COST GROWTH?

The magnitude of cost growth is obviously a function of the definition being used. This section will examine the magnitude of cost growth from both the GAO perspective and the DoD perspective. Additionally, it compares cost growth in DoD acquisition programs to similar efforts in other government agencies and the private sector.

THE GAO PERSPECTIVE

In the 1970s, the GAO published a series of reports that documented cost growth in DoD major acquisition programs. The results of these reports were based on reviewing SARs from all services. For the five reports reviewed, the sample size ranged from thirty-eight to seventy-seven. In comparing the current program estimates to the planning estimates, the GAO found average cost growths of 40-50%. When comparing the current estimate to the development estimate, the GAO reported average cost growths of 20-30%. To put this in perspective, the forty-nine SARs reviewed for the 1974 GAO report revealed a total cost growth of \$55.3 billion over the total planning cost estimates and \$38.4 billion over the total development cost estimates (Status of Selected 4).

GAO reports in the 1980s tended to focus on a smaller number of programs, but analyzed them in greater detail. For example, a 1987 report⁴ reviewed nineteen programs, and a 1989 report⁵ reviewed thirteen programs. However, in 1988, the GAO once again did a top-level review of ninety-nine programs. They found a 41% cost growth when comparing the current estimate to the development estimate made at Milestone II (Analysis of Major Weapon 9).

⁴ DoD Acquisition Programs: Status of Select Systems. GAO, Apr. 1987.

⁵ Defense Acquisition Programs: Status of Selected Systems. GAO, Dec. 1989.

Not all programs examined by the GAO experienced cost growth problems. Some were developed under cost; however, there were some extreme cases, such as the Blackhawk helicopter program which experienced a 237% cost growth.

THE DOD PERSPECTIVE

RAND Results

In 1979, Dews et al. examined the effectiveness of DoD acquisition policy in the 1970s. They used the cost growth ratio previously defined to compare Milestone II estimates with the current program cost estimates. A review of twenty-one major programs revealed an average cost growth of 20%. In examining just the mature programs--three years past Milestone II--the results were an average cost growth of 34%. This equates to an average annual cost growth of 5-6% per year (33-39).

In 1987, Michael Rich and Edmund Dews compared cost growth in the last three decades. The average annual cost growth (over and above inflation) was 7.6% for the 1960s. In the 1970s, it was 5.8%. For the first half of the 1980s, it was 4.4% (2). RAND is currently completing another cost growth study that will update its previous efforts. The report should be published in the April 1993 time-frame.

IDA Results

IDA has completed several cost growth studies for DoD. In 1989, Tyson et al. completed a comprehensive examination of cost and schedule trends for DoD major acquisition programs. This study examined eighty-nine acquisition programs from the previous thirty-two years. The sample population included programs from all services, programs from nine equipment categories, programs with varying degrees of success, new development programs, and modification programs. The average cost growth from the Milestone II estimate to the current estimate or actual cost was 51%, which is substantially higher than the results reported by RAND (30%) in 1979. Two factors could contribute to this difference:

- * The IDA database is different than the RAND database.
- * The IDA methodology for calculating cost growth is different than the RAND methodology.

This report also examined cost growth on a decade basis. The results are shown in Table 1. Although expressed in different terms, these results agree with the RAND analysis that showed a slight improvement over the decades in reducing cost growth. The 1980's results appear promising, but they are based on a small sample size and will likely increase over time since cost growth tends to increase as programs mature (IV-1 thru IV-2).

Table 1. Cost Growth Results by Decade

Decade	Dev CG	Prod CG	Total CG
1960s	36%	89%	66%
1970s	26%	63%	51%
1980s	16%	-9%	-8%

Source: Tyson et al., Acquiring Major Systems: Cost and Schedule Trends and Acquisition Initiative Effectiveness.

IDA, Mar. 1989.

Bliss' Results

Gary Bliss, a cost analyst in OSD, completed a cost growth study with some updated estimates in 1991. Using the RAND database and methodology for defining cost growth, he obtained an average total cost growth of 33.2% when comparing the current estimates to the Milestone II development estimates on 107 programs.

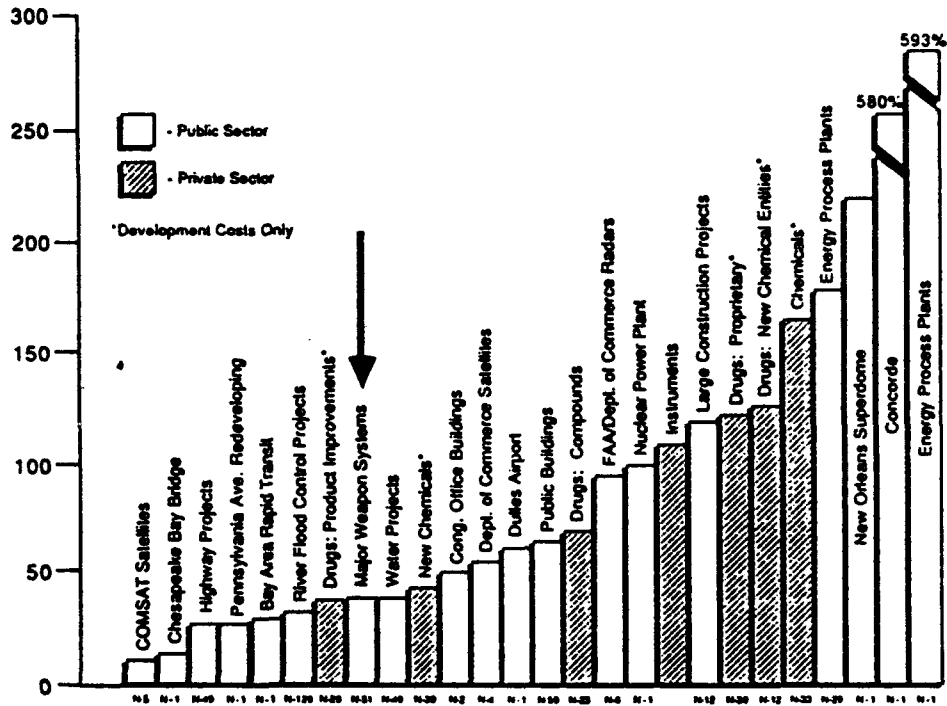
CONCLUSIONS AND COMPARISONS

As mentioned earlier, comparing results between cost growth

studies is dangerous because different assumptions and methodologies may skew the comparison. However, from a top-level perspective, the GAO and RAND results are in the same ball park. The IDA results are somewhat higher but follow the same trend. The average cost growth for major programs in the last three decades has been somewhere between 20% and 50% depending on which estimate was used as a starting point--the planning estimate or the development estimate. The trend has been a gradual decrease in the magnitude of cost growth over the decades.

How does cost growth in DoD compare with similar developments in other government agencies and the private sector? Figure 1 shows a comparison of cost growth in a variety of major projects. Based on this comparison, DoD is doing a relatively good job. However, that fact evokes little sympathy from either Congress or the American public. Cost growth not only causes major perturbations to the DoD budgeting process, but also has a real cost in terms of DoD funding. Jacques Gansler, an acknowledged defense acquisition expert, believes that cost is around \$15 billion annually (133).

Figure 1. Cost Growth in Major Projects (adjusted for inflation and quantity)



Source: President's Blue Ribbon Commission on Defense Management.

"A Formula for Action." Apr. 1986.

WHAT FACTORS CAUSE COST GROWTH?

COST GROWTH CATEGORIES

Over the years a myriad of factors have been attributed to program cost growth. Various organizations and individuals have categorized these factors in a variety of ways:

- * GAO reports have normally addressed cost growth factors based on the seven variance categories in the SAR.
- * A 1979 RAND report also addressed cost growth factors based on the seven SAR categories. However, it added two more categories: "Contract Performance Incentives" and "Unpredictable" (Dews et al. 40).
- * A 1980 IDA report provided a laundry list of the factors that have been attributed to cost growth (Asher and Maggelet 8-9).
- * A 1982 HASC panel report categorized cost growth factors as either: 1) controllable--under the control of the program manager or 2) uncontrollable--outside the program manager's control (United States 1).
- * Bliss chose a similar approach. He divided cost growth factors into two categories: external and internal. External factors were those variances resulting from decisions made external to a program Milestone II baseline. Internal factors were those variances that the Milestone II estimate could have foreseen (5).

This report uses a different approach. To provide better insight into the basic causes of cost growth, it identifies five categories of cost growth factors:

- * Requirements definition
- * Cost estimating

- * Program management
- * Contracting
- * Budgetary

This approach was selected because it facilitates correlating the factors attributed to cost growth with the initiatives DoD has taken to reduce cost growth. Table 2 lists various cost growth factors by category. This list isn't all inclusive, but it does identify the factors that were cited in the thirty-three sources reviewed for this research project.

THE MAGNITUDE OF COST GROWTH FACTORS

In most instances these factors were identified through case studies, surveys, or personal observations. Some of these factors have been identified more frequently than others and obviously have a greater influence on program cost growth. Various organizations and individuals have attempted to quantify the magnitude of some of these cost growth factors. Additionally, RAND, IDA, and Bliss have completed statistical analyses to identify significant factors that influence program cost growth. Both RAND and IDA have, in past studies, developed methodologies for improving cost estimates to account for cost growth. The remainder of this section highlights

Table 2. Factors Attributed to Cost Growth

Requirements Definition

- * Poor initial requirements definition
- * Poor performance/cost trade-offs during development
- * Changes in quantity requirements

Cost Estimating

- * Errors due to limitations of cost estimating procedures
- * Failure to understand and account for technical risks
- * Poor inflation estimates
- * Top down pressure to reduce estimates
- * Lack of valid independent cost estimates

Program Management

- * Lack of program management expertise
- * Mismanagement/human error
- * Over optimism
- * Schedule concurrency
- * Program stretch outs to keep production lines open

Contracting

- * Lack of competition
- * Contractor buy-in
- * Use of wrong type of contract
- * Inconsistent contract management/administrative procedures
- * Too much contractor oversight and reporting requirements
- * Waste
- * Excess profits
- * Contractors over staffed
- * Contractor indirect costs unreasonable
- * Taking too long to resolve undefinitized contracts

Budgetary

- * Funding instabilities within DoD caused by trying to fund too many programs
- * Funding instabilities caused by congressional decisions
- * Inefficient production rates due to stretching out programs
- * Defense Acquisition Board (DAB)--formerly DSARC--out of synchronization with the services' Program Objective Memorandum (POM) cycle
- * Failure to fund for management reserve
- * Failure to fund programs at most likely cost

the key results in quantifying cost growth factors.

GAO Results

The GAO has quantified cost growth factors from several different perspectives in various reports:

- * Seven variance categories in the SAR
- * Type of system
- * By service (e.g., Navy, Army, Air Force)

However, it's difficult to draw any conclusions on the magnitude of cost growth factors because these reports were a snap-shot in time versus a trend analysis. For example, a 1971 GAO report⁶ showed the Army with the lowest cost growth (29%) in its major programs, but a 1988 report⁷ showed it had the highest among the services (99%).

RAND Results

Like the GAO, RAND has also quantified the magnitude of cost growth

⁶ Acquisition of Major Weapon Systems. GAO, Mar. 1971.

⁷ Weapons Costs: Analysis of Major Weapon Systems Cost and Quantity Changes. GAO, Nov. 1988.

factors based on the seven variance categories in the SAR. In 1979, Dews et al. compiled the cost growth data on thirty-one programs being developed by DoD during the 1970s. They quantified cost growth as the aggregate percentage of cost increase from the total development estimates (\$21.1 billion) of all thirty-one programs. The three most significant categories were Schedule (5.6%), Engineering (3.7%), and Estimating (2.1%) To put these figures in perspective, the 5.6% cost growth attributed to schedule variance represents a total cost growth of \$1.137 billion for all thirty-one programs (42).

Almost a decade later, Rich and Dews examined cost growth factors using statistical analysis, but reported they were "largely unable to separate the causes of lower cost growth...." (3) RAND is in the process of completing an updated report on DoD cost growth. An interview with Jeff Drezner of RAND revealed that this report was also unable to statistically identify significant cost drivers; however, he identified two factors which have somewhat of an impact on cost growth:

- * Small programs tend to have greater cost growth than large programs. A possible explanation for this observation is larger programs receive more oversight and scrutiny.
- * As a program matures, its cost growth increases. A rational explanation for this observation is as a program matures, the requirements and technical challenges are

understood in greater depth. This permits more precise cost estimates and tempers the original optimism.

In 1965, Robert Summers developed a formula using multiple regression analysis techniques to adjust cost estimates. The formula was designed to quantify how low a cost estimate is likely to be. Two major caveats to the formula were: 1) it didn't have universal application, and 2) it may not apply to future systems (9). I uncovered no evidence that DoD ever used this formula.

IDA Results

In 1989 Tyson et al. quantified cost growth as a function of the type of system being developed, program phase, and new programs versus modification programs:

- * Type System. They examined nine categories of systems. Tactical munitions programs had the highest total program cost growth--an average of 100%. Electronic programs had the highest development cost growth--just under 40%.
- * Program Phase. They only examined cost growth in two phases. The average EMD cost growth (27%) was less than the average production cost growth (65%).
- * New vs Modification. As expected, the average cost growth (54%) in the new programs examined was greater than the

average cost growth (46%) in modification programs. Two exceptions to this finding were tactical munitions programs and electronic programs (IV-6 thru IV-13).

They also completed a quantitative analysis of a variety of factors to statistically determine which factors significantly affect cost growth in major systems. Their results identified three factors at the 95% confidence level:

- * Growth in the development schedule
- * Decisions to "stretch out" programs
- * The length of the development schedule (IV-6 thru IV-7)

In 1980, Asher and Maggelet developed a formula to project the probable cost of a weapon system at its initial deployment. The basis for this formula was the development of cost growth functions for four categories of equipment--airplanes, ships, missiles, and other. They recommended the formula be used by IDA for future evaluations and also stated it might be useful to DoD agencies (64-65). A potential problem with this methodology was the small sample size used to develop the cost growth functions. For example, the ship cost growth function of 1.37 was based on a sample size of 5 ships. I found no evidence that this formula was adopted by any organization.

Bliss Results

Using the RAND database, Bliss accomplished a statistical analysis of cost factors in 1991. Many of his findings contradict the IDA results just presented:

- * He found that average cost growth (39.6%) in EMD was greater than average cost growth (25.4%) in production (6). This is the inverse of the IDA findings. Additionally, IDA's production cost growth figure was more than twice that reported by Bliss.
- * Bliss also examined seven factors using statistical analysis to determine if any were significant in explaining program cost growth. His results indicated program size and type system were the most significant. What's more interesting is the factors that didn't prove to be significant--technical challenge, slips in EMD, and program stretch. These findings contradict the IDA results and conventional wisdom on many of the factors attributed to cost growth (7).

INITIATIVES TO REDUCE COST GROWTH

Over the last three decades, DoD has implemented numerous policy and regulation changes to improve the acquisition process and

reduce cost growth. This report will not attempt to identify every change. Rather, it will focus on some of the key changes made to combat cost growth. Two major attempts at improving program cost growth were the Packard Initiatives and the Carlucci Initiatives.

- * In the early 1970s, Deputy Secretary for Defense David Packard implemented ten initiatives to improve the DoD acquisition process. Several of these were aimed at reducing cost growth.
- * In 1981, Frank Carlucci, Deputy Secretary of Defense, implemented the Defense Acquisition Improvement Program (DAIP), also known as the 33 Initiatives, to improve the entire acquisition process. It also included several initiatives specifically targeted at cost growth.

In 1989, DoD published the Defense Management Report to the President, which outlined its plan to fully implement the Packard Commission's recommendations and improve the defense acquisition system. This plan contained several initiatives which should reduce cost growth in major systems. However, it's too soon to determine if those initiatives have had any impact (Cheney i).

Table 3 lists some representative actions taken by DoD as a result of these major initiatives as well as other policy changes to combat the factors attributed to cost growth. Additionally, there are a few initiatives, such as the Competition in Contracting Act

Table 3. Initiatives to Combat Cost Growth

Requirements Definition

- * Strategies-to-task approach for identifying requirements
- * COEAs required at Milestones II, III, and IV

Program Management

- * Established required training for program managers
- * Established the professional acquisition corps
- * Required adequate front end funding or test hardware
- * Established DSARC (later DAB) for program oversight
- * Increased program manager's authority
- * Established Value Engineering policy

Cost Estimating

- * Established Cost Analysis Improvement Group (CAIG)
- * Established approved inflation factors
- * Stressed need for prototyping to gain greater insight into risks and costs
- * Established Preplanned Product Improvement (P3I) policy to reduce program risks
- * Established program baselining requirement
- * Established Should Cost reviews

Contracting

- * Improved source selection procedures to prevent "buy-in"
- * Stressed use of appropriate type contract
- * Established procedure to obtain better estimate of contractor's overhead
- * Instituted CICA
- * Implemented acquisition streamlining
- * Eliminated firm fixed price contracts for major development efforts

Budgetary

- * Directed services to fully fund programs to protect schedule
 - * Instituted milestone budgeting (Defense Enterprise program)
 - * Directed programs to budget for technical risk
 - * Directed programs to budget to most likely cost
 - * Implemented Multi-year Procurement (MYP)
 - * Directed use of economic production rates
-

(CICA) that were mandated by Congress. These initiatives are listed according to the same categories used in the previous section to identify cost growth factors. A comparison of this list with the factors list in Table 2 reveals that DoD has made a concerted effort to attack many of the factors attributed to cost growth.

ASSESSMENT OF DOD'S COST GROWTH INITIATIVES

The preceding section highlighted many of the initiatives DoD has implemented to control cost growth in its acquisition programs. How successful have these programs been? The answer depends on who you ask. This section will provide an overall assessment of these initiatives, an assessment of the two major initiative packages (Packard and Carlucci), and an assessment of some of the individual initiatives.

OVERALL ASSESSMENT

Both RAND and IDA have examined cost growth over the last three decades. As mention earlier, RAND reported a decrease in the average linear rate of cost growth in the last three decades. Based on these results, Rich and Dews concluded that "government and industry management can claim at least modest improvements over

time" (2).

IDA researchers reached a slightly different conclusion:

Program cost trends have neither been getting uniformly better nor uniformly worse over time. If the data are organized by FSD start date, the total program cost growth was higher during the late 1960s, lower in the early 1970s, and higher in the late 1970s (Tyson et al. viii).

They didn't believe they had enough data to make a valid observation for the 1980s.

Although RAND and IDA came to different conclusions, both their results show a small improvement in cost growth over the last three decades. This improvement could be attributed to the numerous initiatives DoD has implemented; however, there is no solid, analytical evidence to prove that assertion.

ASSESSMENT OF MAJOR INITIATIVE PACKAGES

Packard Initiatives

A 1979 RAND report assessed DoD had substantially complied with the

Packard initiatives (Dews et al. vii) Although both RAND and IDA reported cost growth decreased slightly during the 1970s, it's difficult to make a strong case that this decrease was a result of the Packard initiatives for two reasons:

- * IDA showed two of the key Packard initiatives--prototyping and Design-To-Cost--were statistically insignificant factors in explaining cost growth (Tyson et al. V-4).
- * The same IDA report evaluated 1970's cost growth in two segments--the early 1970s and the late 1970s. While the average cost growth had decreased to 37% in the early 1970s, it was back up to 59% in the latter half of the decade (Tyson et al. IV-2). If the reforms worked in the beginning of the decade, why didn't their effect last?

Carlucci Initiatives (DAIP)

In 1983, Adams, Murphy, and Rosenau provided a very negative assessment of DAIP effectiveness:

The Defense Department's procurement initiatives pay lip service to two decades worth of studies, which consistently fault wasteful Pentagon management philosophy, contract negotiations and management procedures, the nature of the defense market, inefficiencies within

contracting companies, and politics for vast overruns paid out of tax dollars (42).

The GAO made two assessments of DAIP. The first was a 1986 survey of fifty-four DoD program managers and sixty-five industry program managers on the effectiveness of DAIP. The GAO report consolidated the opinions of these 119 program managers on various aspects of DAIP. The bottom line opinion was 57% of the government program managers and 67% of the industry managers believed DAIP had little or no impact (Acquisition: DoD's 7).

In a second study⁸ 5 years after DAIP implementation, the GAO reported that twenty-three of the thirty-three DAIP initiatives had not been fully implemented. The GAO defined "fully implemented" as 1) a complete action plan and 2) a mechanism for monitoring the results was in place. DoD either concurred or partially concurred with all the GAO findings except one. It believed that its projected Multi-year Procurement (MYP) savings were, in fact, correct.

ASSESSMENT OF INDIVIDUAL INITIATIVES

In 1989, IDA researchers made qualitative assessments of six

⁸ Acquisition: Status of the Defense Acquisition Improvement Program 33 Initiatives. GAO, Sep. 1986.

individual DoD initiatives to curb cost growth:

- * MYP has been successful. Of the programs reviewed, MYP programs only had a total cost growth of 31% compared to a total cost growth of 54% for non-MYP programs.
- * Competition has had mixed success.
- * Prototyping has been generally successful.
- * Design-to-Cost has been unsuccessful.
- * Fixed price contracts and Total Package Procurement (TPP) were unsuccessful when used for high-value, high-cost, high-risk, long-term programs.
- * Contract incentives have been successful in reducing costs in some system developments (Tyson et al. ix-x).

In a more rigorous assessment of cost growth initiatives, IDA completed statistical analysis of eight acquisition initiatives to determine if they were a significant factor in cost control. The results were:

- * Three factors had a statistically significant relationship for some types of systems being developed:
 - * Incentive contracts in EMD and production resulted in lower costs.
 - * TPP led to increased production cost and total program cost.

- * Fixed price contracts in EMD resulted in higher cost programs.
- * The following initiatives were statistically insignificant:
 - * MYP
 - * Competition in production
 - * Prototyping
 - * Design-to-Cost (Tyson et al. V-3 thru V-4)

In accomplishing this analysis, IDA didn't attempt to judge how effectively these initiatives were being implemented. It only examined whether they were being used or not. This might account for the apparent dichotomy between some of the qualitative assessments and the quantitative results. For example, while MYP was qualitatively judged to be a success by examining some specific programs, on a whole it proved to be statistically insignificant in explaining reductions in cost growth.

CONCLUSIONS

SUMMARY

Just over twenty years ago, Joseph Metcalf completed a research project similar to this one while attending the Army War College.

He made the bold prediction that "By 1980, cost-overruns may be a thing of the past" (48). Unfortunately, he was wrong. It's difficult to be optimistic about DoD's ability to control or eradicate cost growth in acquisition programs after reviewing the track record for the last three decades. RAND and IDA studies indicate that cost growth from EMD through production has averaged 20-50%. GAO reports indicate the cost growth from the planning estimate made in CED through production has averaged 40-50%. Despite countless studies and a myriad of recommendations and initiatives, cost growth is still a significant problem today as exemplified by the C-17 program.

However, the cost growth problem should be put in perspective:

- * The DoD acquisition process has continued to deliver the best military hardware in the world.
- * There is some evidence from both the RAND Corporation and IDA that cost growth has been slightly reduced over the last three decades.
- * When compared to programs of similar magnitude and technological risk, DoD acquisition programs fare very well in their ability to control cost.
- * Not all programs experience cost growth. Some even come in under cost!
- * The acquisition process is extremely complex involving hundreds of variables and thousands of people. This is

reinforced by the often contradictory claims and recommendations on the causes of cost growth.

- * The budgetary process isn't a strict exercise in efficient resource allocations. Many decisions made in both in DoD and Congress are based on political considerations vice strict resource allocation considerations.

In spite of these mitigating factors, cost growth is still a major problem. It robs DoD of public confidence. It injects considerable turbulence into the resource allocation process. It forces decisions that exacerbate the cost growth problem by stretching program length due to inefficient production rates. It impacts military force structure by forcing reductions in the number of systems bought to meet total program funding constraints.

IMPACT ON TODAY'S ENVIRONMENT

Many of these problems could be magnified in today's environment of a declining defense budget and a shrinking defense industrial base.

As the defense industrial base shrinks, the surviving companies--hungry for work--will be tempted to "buy-in" to contracts just to keep their work force employed.

One of the changes in the latest version of DODI 5000.2 was a

revision of the process for selecting programs to meet user requirements. During Concept Exploration and Development, the services are required to complete a Cost and Operational Effectiveness Analysis (COEA) to evaluate various options for meeting the user's requirement. If these early cost estimates are optimistic, which history indicates they will be, it could invalidate the decision on the best option to carry into EMD. This could be a major problem in two circumstances:

- * Evaluating diverse options. For example, evaluating whether a tactical missile solution is better than an aircraft solution. According to IDA results, a tactical missile program is more likely to experience greater cost growth than an aircraft program.
- * Evaluating new systems versus modifications. Historical data indicate new systems will have greater cost growth than modification programs. Therefore, new systems may initially appear more attractive.

All of the impacts from the new environment won't be negative. The new DoD acquisition philosophy is to accept less risk by taking longer to mature technology and to develop weapon systems. This philosophy should result in less cost growth since one of the primary factors attributed to past cost growth has been high risk (technology and schedule) programs. However, a negative side-effect of increasing the time to field systems is that they will

lose their technological edge sooner. This will require system modifications earlier in their operational life than in the past.

RECOMMENDATIONS

I will avoid the temptation to make numerous, broad-sweeping recommendations like "increase program stability." Most of these type recommendations have already been made in previous studies. DoD has even tried to implement some of them. Several of the initiatives in the DAIP were specifically aimed at increasing program stability, but the historical evidence indicates they were less than fully successful.

Rather, I have made four modest recommendations that might have some success in being implemented.

1. Establish measures of merit for evaluating the effectiveness of future initiatives to improve cost growth. This recommendation has been made before; however, in this era of Total Quality Management (TQM), it has a better chance of successfully being implemented. One of the basic tenets of TQM is to continually improve the process. That's difficult to accomplish if you don't have some method for measuring improvement. Both DoD and the GAO have spent thousands, if not millions, of dollars trying to resurrect historical information, analyze it, and assess the impact of past

initiatives to curb cost growth. By establishing a measurement system, the information needed to assess the impact of initiatives will be readily available for interpretation. Therefore, DoD will no longer have to fund outside organizations to go through the time-consuming task of gathering historical data. Implementing a measurement system isn't cost free; it takes time, resources, and expertise. However, in the long run, it will pay off.

2. Continue studies to identify fundamental causes of cost growth through statistical analysis. Although these types of studies aren't cheap, the potential payoff is high. There are many qualitative assessments of the factors that cause cost growth. However, there is not much quantitative proof that these assessments are correct. In fact, my research indicates that the little quantitative analysis that exists is contradictory on the factors that cause cost growth. If DoD were able to specify with some certainty the factors that cause cost growth, it could take concrete steps to curb cost growth. Two potential areas for further investigation are:

- * Determine if the interaction of cost growth factors is statistically significant in explaining program cost growth. Past studies have examined factors individually. Maybe the interaction of these individual factors is more important in predicting cost growth than the individual factors themselves.

- * Continue efforts to develop a formula or "fudge factor" for predicting program cost growth. Asher and Maggelet's methodology with a larger sample size for computing the median cost growth function may prove useful.

3. Factor cost growth into COEAs as part of a sensitivity analysis. DoD 5000.2-M directs the completion of a cost uncertainty analysis. This analysis can be done objectively, through statistical analysis, or subjectively based on expert opinion. IDA studies have shown that the likelihood of cost growth is greater in certain types of programs--tactical munitions, electronic programs, and new starts versus modifications. This type of information should be factored into COEAs as part of a sensitivity analysis when completing the cost uncertainty analysis. For example, if cost growth in tactical missile programs has historically been 30%, the COEA cost estimate could be inflated by 30% to show a worst case cost estimate. I believe this would be useful information for decision-makers to evaluate as they select the best option to meet a user's need.

4. Examine the feasibility of increased management reserve for programs with high cost growth risk. This study would review the existing major acquisition programs to determine which were most likely to experience major cost growth based on past studies. Once these programs were identified, they would be evaluated to determine what additional management reserve funding would be

required to cover potential cost growth. The final part of the study would entail analyzing the impact on the DoD budgeting process by answering such questions as:

- * What would be the total management reserve required?
- * What would be the impact on other program funding?
- * What would be the impact on flexibility to the budgeting process?
- * How would additional funds be used if the management reserve weren't needed.

These recommendations won't win the war on cost growth that DoD has been battling for the last three decades. However, they will provide additional ammunition which can be used to fight the battle. And, it appears that DoD is going to need all the ammunition it can get. According to an 8 February 1993 U.S. News & World Report article, "the GAO predicts that planned weapons programs will cost an additional \$35 billion between now and 1997.... (37).

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