COST OVERRUN OPTIMISM:
Fact or Fiction?

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Program managers are advocates by necessity. When taken to the extreme, program advocacy can result in the suppression of adverse information about the status of a program. Such was the case in the Navy's A-12 Program. In A-12 Administrative Inquiry, Beach (1990) speculates that such "abiding cultural problems" were not unique to the Navy. To test that assertion, this paper examines cost overrun data on 64 completed acquisition contracts extracted from the Defense Acquisition Executive Summary database. Cost overruns at various contract completion points are compared with projected final cost overruns estimated by contractor and government personnel. The comparison shows that the overruns projected by the contractor and government were excessively optimistic throughout the lives of the contracts examined. These results were found insensitive to contract type (cost, price), contract phase (development, production), the type of weapon system (air, ground, sea), and the military service (Air Force, Army, Navy) that managed the contract.

According to Gansler (1989, p. 4), the average cost overrun on a major defense contract has been about 40 percent. Although some of the causes of cost overruns are beyond the control of program managers, supporting an unrealistically low estimate of the final cost of a defense contract can only harm the program in the long run. The cancellation of the Navy's A-12 program in January 1991 is a highly publicized example of this problem.

Chester P. Beach (1990), the Inquiry Officer of the A-12 cancellation, reported that pessimistic projections regarding the program's cost were suppressed to protect the program and the careers of key managers. When Secretary of Defense Dick Cheney canceled the program in January 1991, he complained

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that no one could tell him its final cost (Morrison 1991). In fact, there were many estimates of the program's completion cost; some estimates were more than $1 billion higher than the ones supported by the government program office and by the contractors. The problem was the delayed and reluctant communication of the pessimistic estimates to key decision makers above the government program office. Although no one can say with certainty that the timely communication of more realistic estimates would have saved the A-12, it seems likely that at least part of the $1.35 billion in excess progress payments made to the contractors could have been avoided (Feber & Math, 1991).

More realistic estimates and a culture that will tolerate them are needed. Program managers/directors are necessarily advocates of their programs. However, program advocacy is no excuse for suppressing critical information about a program's cost, schedule, or technical performance. In an acquisition policy letter, J. J. Welch (1991), Assistant Secretary of the Air Force (Acquisition), wrote:

> *A program director (PD) must be an advocate of his or her program. . . . The PD's advocacy must not cross the line into attempting to "sell" the program, but must clearly be viewed as supportive to the user's requirements. The PD must articulate the pros and cons, as well as the "maturity curve" status, in a clear and comprehensive manner to preclude unfulfilled expectations or surprises. Such advocacy must be based on honesty and integrity to accurately portray program status.*

Regardless of this policy statement, Gansler (1989, p. 212) reports that the majority of the program managers' time is spent "selling" their programs to budget committees. In addition, research has shown that, once a program is more than 15 percent to 20 percent complete, it is highly unlikely that the final cost overrun will be less than the present cost overrun (Abba, 1992; Christensen & Payne, 1992; Heise, 1991; Wilson, 1991). Despite these facts, contractor and government program managers often claim optimistically that dramatic recoveries from cost overruns are possible.

Using information extracted from the *Defense Acquisition Executive Summary* (DAES) database, this paper documents the optimistic forecasts of contract completion costs on 64 completed contracts. Average cost overruns at various contract completion points are compared with projected final cost overruns estimated by contractor and government personnel. The comparison shows that the overruns projected by the contractor and government were exceedingly optimistic throughout the lives of the contracts examined. These results were found insensitive to contract type (cost, price), contract phase (development, production), the type of weapon system (air, ground, sea), or the Military Service that managed the contract.

BACKGROUND

Cost overruns and projected final overruns are regularly reported on cost management reports prepared by the contractor. These reports include the Cost Performance Report (CPR) and the Cost/Schedule Status Report (C/SSR). Department of Defense Instruction 5000.2 stipulates that a CPR be submitted for contracts which require compliance with the Department of Defense (DOD) cost/schedule control systems criteria (C/SCSC) (Department of Defense, 1991). For contracts not required to comply with the criteria, the C/SSR is usually required.[1]

Cost/schedule control systems criteria are not a management system. Instead, they establish minimal standards for the management control systems used by the contractor and have two objectives:

1. For contractors to use effective internal cost and schedule management control systems and

2. For the government to be able to rely on timely and auditable data produced by those systems for determining product-oriented contract status (Department of the Air Force [DAF], 1989).

Implicit in these objectives is the assumption that, if the contractor's management control systems comply with the criteria, the data generated by those systems are reliable (Christensen, 1989).

Data summarizing a contract's cost and schedule performance are listed in the cost-management report. Key data elements of the report are shown in Figure 1. The budgeted cost of work scheduled (BCWS) is the sum of budgets allocated to time-phased elements of work on the contract, known as work packages and planning packages. The cumulative expression of these budgets, the performance measurement baseline, takes on a characteristic S-shaped curve. The end point of the baseline, the budget at completion (BAC), represents the total budget of all the identified work on the contract.

As shown in the figure, the contractor also reports an estimate of the final cost of the contract, termed the estimate at completion (EAC). The EAC is an extrapolation of the cumulative actual cost of work performed (ACWP) to the end of the contract. If the projected final cost differs from the total budget, the contractor is predicting a cost overrun at completion. It is often revealing to compare the predicted cost overrun at completion to the present cost overrun. If the present overrun is worse than the predicted final overrun, the contractor is predicting effectively that the cost of the remaining work on the contract will

1 Compliance to C/SCSC is required on significant contracts and subcontracts within all acquisition programs. Significant contracts are research, development, test and evaluation contracts with an estimated cost of $60 million or more (in fiscal 1990 constant dollars) or procurement contracts with an estimated cost of $250 million or more (fiscal year 1990 constant dollars) (Department of Defense, 1991, p. 11-B-2).

be less than budgeted. For this paper the present cost overrun is defined as the difference between the cumulative budgeted cost for work performed (BCWP) and the cumulative ACWP.[2] The BCWP is the same number as BCWS but is recorded when work is actually accomplished. Clearly, if the cost of the completed work exceeds the budget, a cost overrun is identified. If the cost overrun is significant, it is investigated to determine the cause. Hopefully, the timely and disciplined analysis of significant overruns will result in corrective action before the problems become serious.

The effectiveness of variance analysis depends on organizational culture. In a healthy culture a variance is considered an opportunity for improvement. In an unhealthy culture a variance is bad news, and individuals or even organizations responsible for unfavorable variances may be punished. The result of this "shoot the messenger" culture can be the suppression of adverse information about a contract's status.

Although routine analysis in the A-12 program revealed adverse trends, the significance of the unfavorable cost and schedule variances was not revealed to senior civilian decision makers above the government program office. According to Beach (1990), the projected final completion costs supported by the contractor and the government program manager were unrealistic. For example, at the 37 percent completion point, the A-12 contractors reported a cost

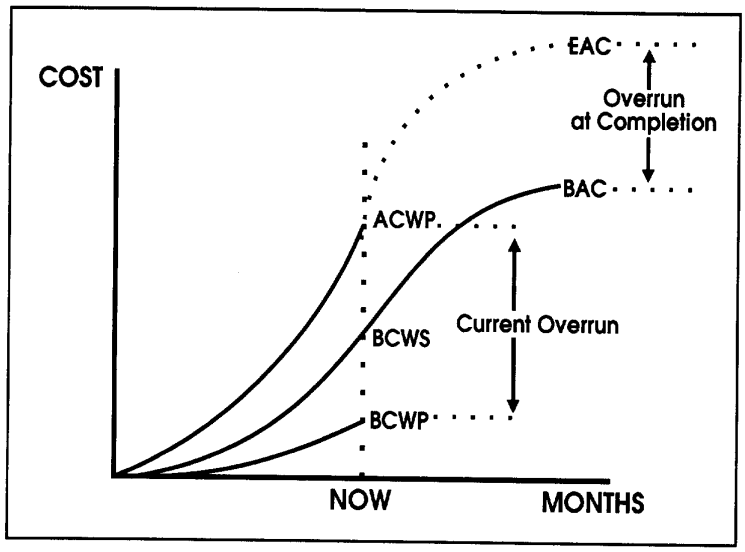

Figure 1.

2 The difference between BCWP and ACWP is defined as a "cost variance" in the *Cost/Schedule Control Systems Criteria Joint Implementation Guide* (Department of the Air Force, 1987). Here, the focus is an adverse cost variance, termed cost overrun.

overrun of $459 million and a projected cost overrun at completion of $354 million (Campbell & Fleming, 1991). The government program manager's estimated final overrun was slightly higher than the contractor estimate yet less than the overrun to date.

Apparently the need to present an optimistic picture was a dominant consideration that effectively suppressed more realistic estimates. Near the end of his report, Beach (1990, p. 41) speculates that this "abiding cultural problem" was not specific to the A-12 but was a problem common to other major defense programs:

> *There is no reason to believe that the factors which made these officials respond the way they did are unique to this Military Department. Indeed, experience suggests that they are not. Unless means can be found to solve this abiding cultural problem, the failures evidenced in this report can be anticipated to occur again in the same or a similar manner.*

This paper provides evidence that supports this assertion by examining available cost data on completed contracts.

METHODOLOGY

The purpose of this study was to determine if the overruns at completion projected by contractor and government personnel are unrealistically optimistic. Research has established that, once a contract is 15 percent complete, the final cost overrun will exceed the cost overrun to date (Abba, 1992; Christensen, 1989; Heise, 1991; Wilson, 1991). Thus, a projected overrun at completion is defined as unrealistically optimistic if it is less than the present cost overrun.

To test the hypothesis, averages of the present cost overrun, the projected cost overrun at completion, and the final cost overrun were computed from a sample of 64 completed contracts extracted from the DAES database (Department Of Defense, 1991). This database contains contractor cost and schedule performance data on more than 500 defense contracts summarized quarterly by government program offices since 1970 (Christle, 1981). Because most of the contracts in this database are C/SCSC-compliant, the data are considered reliable.

Although the sampling technique was purely judgmental, the number and variety of contracts are considered sufficiently large to be general in nature. The period of performance for these contracts ranged from 1971 to 1991. Table 1 lists descriptive statistics on the average final cost overruns in the sample. For sensitivity analysis, the sample was divided into several categories, including contract type (price, cost), contract phase (development, production), the type of weapon system (air, ground, sea), and the Service managing the contract. For each category in the table, the number of contracts and the average, maximum, and minimum values for the final overrun are listed.

Table 1
FINAL COST OVERRUN ON 64 CONTRACTS

	percent OF BUDGET				$ MILLIONS		
Category	Number	Avg	Min	Max	Avg	Min	Max
Fixed Price	41	20	-3	109	34	-3	407
Cost	23	14	-1	46	41	-2	493
Development	25	21	-1	109	38	-2	407
Production	39	16	-3	46	35	-3	493
Air	43	18	-3	109	45	-3	492
Ground	13	21	5	45	23	7	42
Sea	8	12	0	38	12	0	36
Air Force	18	19	-1	109	49	-2	407
Army	28	20	-3	46	21	-3	46
Navy	18	13	0	46	47	0	493
ALL	64	18	-3	109	36	-3	493

Equations 1, 2 and 3 define the current cost overrun, the projected cost overrun at completion, and final cost overrun. Of the three overruns, only the projected cost overrun at completion is an estimate, showing the difference between the budget and the estimated completion cost. The others are simply the difference between the budget and actual cost of the work.

Current overrun (CO) = Cumulative (Cum) BCWP - Cum ACWP (1)
Overrun at completion (OAC) = Contract budget base (CBB) - EAC (2)
Final overrun (FO) = CBB - Final ACWP (3)

To normalize the data, the overruns were converted into percentages using Equations 4, 5 and 6. For the current cost overrun percentage, the cumulative BCWP was used. For the others, the CBB was used. The CBB is defined as the budget for all authorized work on a contract and includes the management reserve budget.

Current overrun percentage = 100*(CO/Cum BCWP) (4)
Overrun at completion percentage = 100*(OAC/CBB) (5)
Final overrun percentage = 100*(FO/CBB) (6)

Each type of overrun (current, at completion and final) was averaged for each category by dividing the number of contracts in that category into the total overrun for that category. The averaging was done at various stages of comple-

tion ranging from 10 - 100 percent completed (Equation 7).

$$\textit{Percentage completed} = 100*(\textit{Cum BCWP/CBB}) \quad (7)$$

Data earlier than the 10 percent completion point were not considered sufficiently reliable. It can take as long as one year from contract award for the contractor to demonstrate C/SCSC compliance. Until then, the data on the cost performance report are suspect.

As shown in Table 2 in null form, there were three hypotheses. Hypotheses one and two compare the average current overrun to the average overrun at completion by the contractor and government during various stages of contract completion. In hypothesis three, the average overruns at completion by the contractor and government are compared.

Table 2
HYPOTHESES TESTED

Null Hypothesis	Interpretation
$H1_o$: $CO \leq KOAC$	Contractor's OAC not optimistic
$H2_o$ $CO \leq GOAC$	Government's OAC not optimistic
$H3_o$: $GOAC \leq KOAC$	Government more optimistic than contractor

KOAC = Contractor's overrun at completion
GOAC = Government's overrun at completion

If hypothesis one is rejected, the KOAC is unrealistically optimistic. If hypothesis two is rejected, the GOAC is unrealistically optimistic. If hypothesis three is rejected, the contractor is more optimistic than the government regarding the projected overrun at completion. A one-tailed "t test" was used to evaluate each hypothesis at the 95 percent level of confidence.

RESULTS

As illustrated in Figure 2a, the hypotheses were generally confirmed. From as early as the 10 percent completion point, the optimism of the projected cost overrun at completion is apparent. Throughout the life of the contract, this estimate was found to be lower than the present and final cost overruns. Also note that the average overrun at completion projected by the contractor was more optimistic than the average overrun at completion projected by the government program office.

Figure 2b shows that the difference between the overruns is statistically significant through most stages of contract completion. When the one-tailed "t statistic" exceeds a critical value of 1.67 ($t_\alpha = .05$ statistic > 1.67), the difference is defined as significant at the 95 percent level of confidence.

As illustrated in Figures 3 through 6, these results were generally insensitive regarding the contract type, contract phase, type of weapon system, and the military service that managed the contract. To facilitate comparisons, the scales of the graphs are the same. The statistical significance of the differences between the overruns was generally confirmed for each category examined. The details, however, are not reported here.

CONCLUSION

Based on an analysis of 64 completed contracts, the overruns at completion predicted by the contractor and by the government program office were unrealistically optimistic. From as early as the 10 percent completion point through

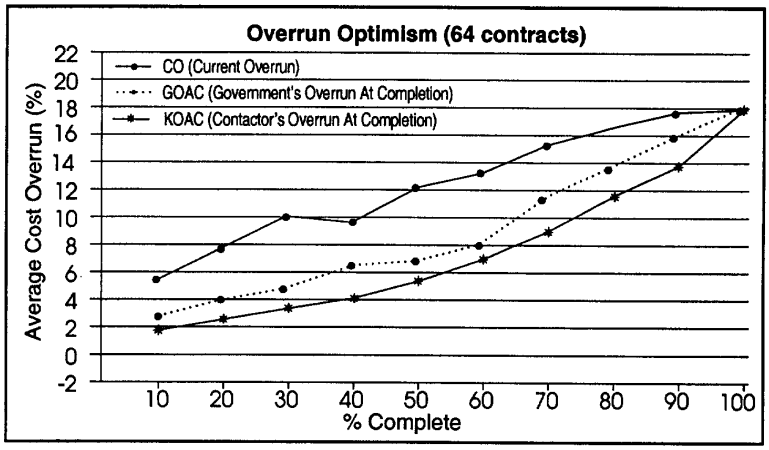

Figure 2a. **Average Overruns For All Contracts in Sample.**

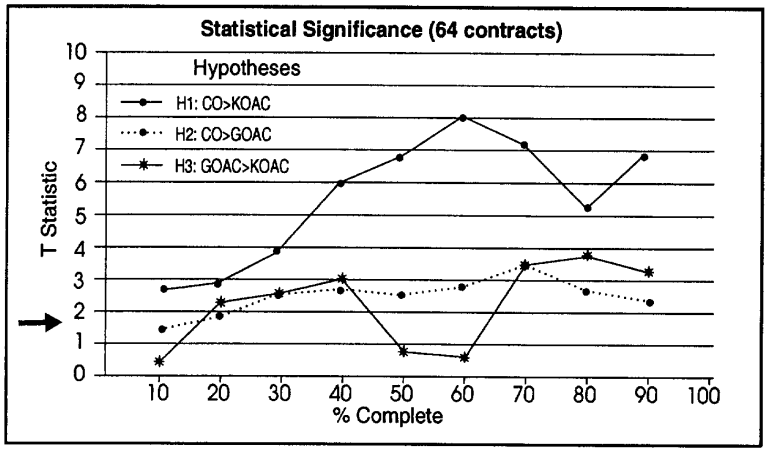

Figure 2b. **Hypotheses Confirmed (For $T_{\alpha = .05}$ statistic > 1.67).**

the end of the contracts, the predicted final overruns were less than the current overruns reported on the contracts. Although the estimates supported by the government program offices were less optimistic than the contractors' estimates, neither was found to be realistic.

Donald J. Yockey (1991, p. 36), then Under Secretary of Defense(Acquisition), called for more realism throughout the acquisition process, including estimating realism. We can't afford to understate, sit on, or cover up problems in any program—at any time—at any level. They must be brought forward.

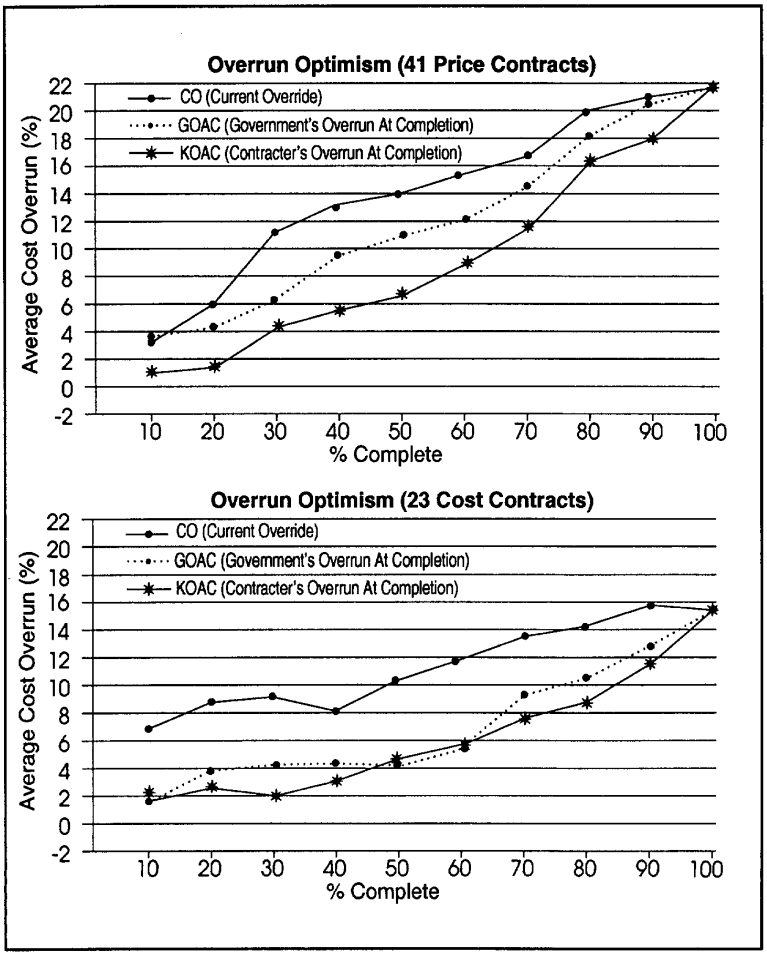

Figure 3. **Average Cost Overruns by Contract Type.**

This includes not just "show stoppers" but also "show slowers." I can't stress this strongly enough.

In an interview with Wayne Abba, a respected analyst at the Office of the Under Secretary of Defense (Acquisition), Mr. Abba commented that adverse trends can be reversed if management pays attention to them (Abba, 1992). Until contractors and program offices are willing to support and advance realistic assessments of a program's status, the attention and expertise of upper-level management is postponed, undoubtedly, in the long run, to the detriment of the program and nation. The famous economist Keynes once stated that, in the long-run, we are all dead (Horngren & Foster, 1991). Postponing or hiding adverse information about a program may be an effective short-run strategy; but, in the longrun, it could result in the cancellation of the program.

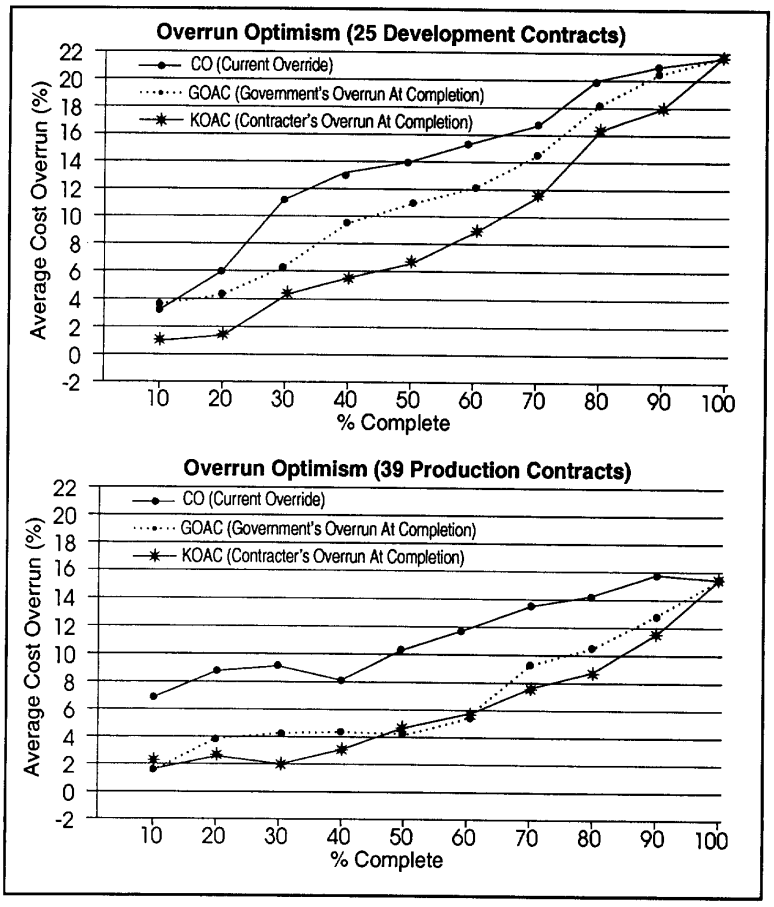

Figure 4. **Average Cost Overruns by Contract Phase.**

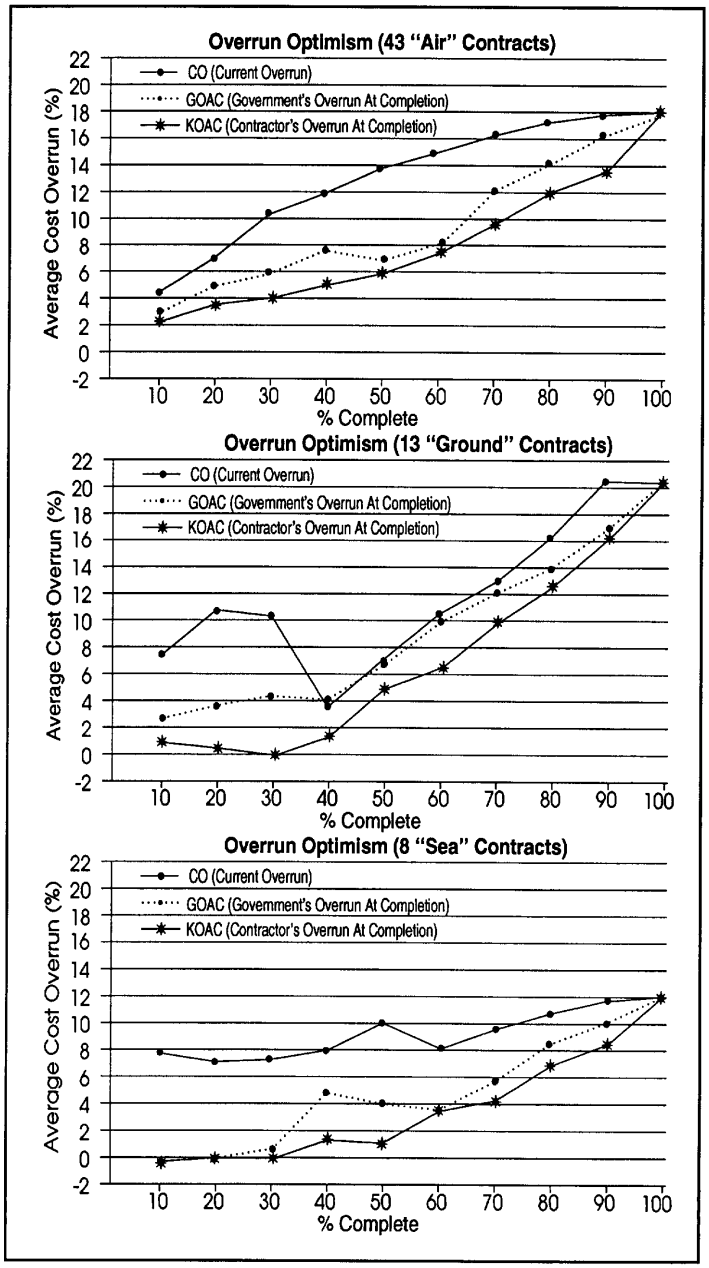

Figure 5. **Average Cost Overruns by Type of Weapon System.**

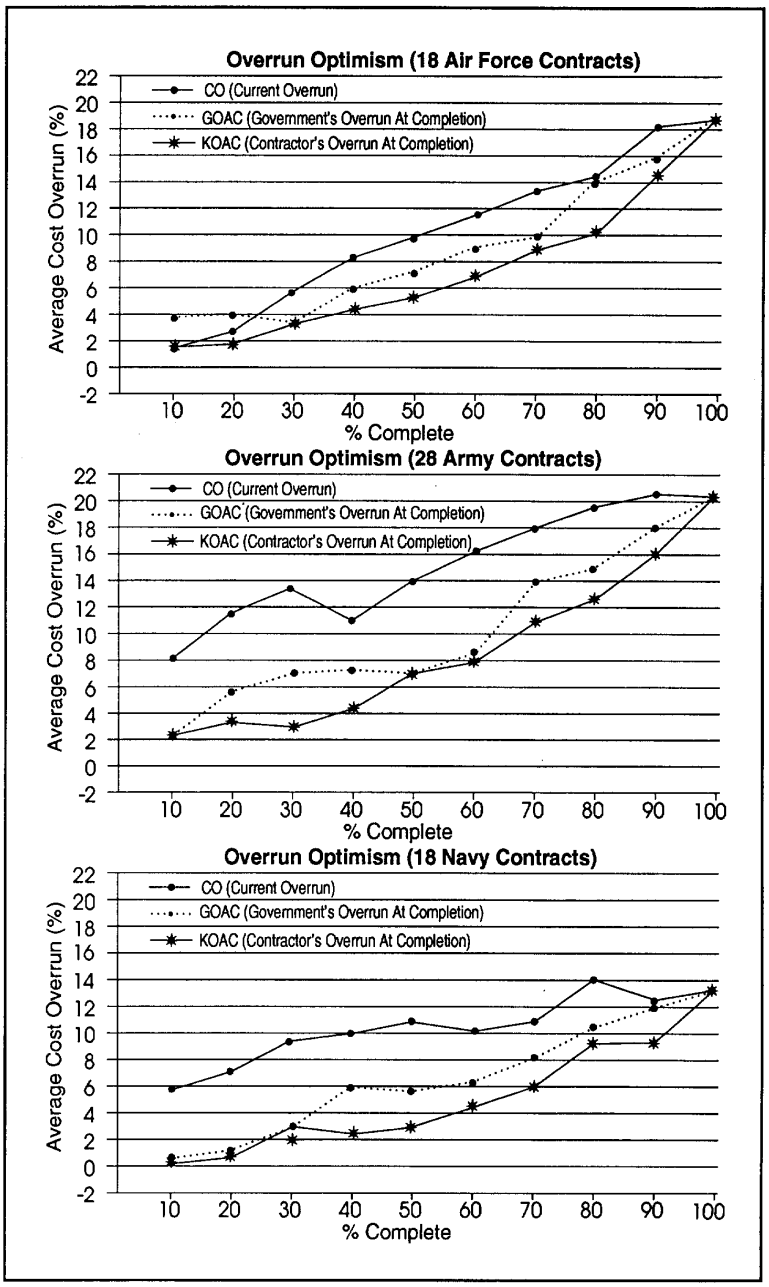

Figure 6. **Average Cost Overruns by Managing Service.**

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