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WHAT THE DEPARTMENT OF DEFENSE NON-MAJOR ACQUISITION PROJECT MANAGER SHOULD KNOW ABOUT COST AND SCHEDULE MANAGEMENT

by

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What the Department of Defense Non-major Acquisition Project Manager Should Know About Cost and Schedule Management

by

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ABSTRACT

In view of a shrinking defense budget, there will likely be an increase in the number of Cost/Schedule Status Report (C/SSR) managed contracts. Thus, it is imperative that the DoD non-major system project manager understand how to integrate performance measurement information and analysis into responsible management decision making. This thesis will focus on what the DoD non-major system project manager should know to accomplish this by providing a comprehensive look at the Cost/Schedule Status Report, its implementation, and report analysis. The thesis will also discuss the Navy A-12 Avenger Aircraft Program termination affect on the C/SSR environment by presenting and analyzing recent initiatives taken to improve performance management, discussing "lessons learned," and providing the researcher's recommendations for future initiatives. Finally, this thesis will analyze proposed C/SSR Joint Guide revisions and provide recommendations for C/SSR improvement.

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I. INTRODUCTION

A. BACKGROUND

In view of planned cutbacks in future defense authorizations, and aroused congressional interest in cost and schedule management following the Navy's A-12 Avenger Aircraft Program termination, it is imperative that the DoD non-major system project manager understand how to integrate both performance measurement information and analysis into responsible management decision making. When rigorously implemented and properly used, the Cost/Schedule Status Report (C/SSR) provides the program manager with objective, standardized cost and schedule performance reporting that enables him to track program progress and initiate corrective actions as required.

The Honorable Donald J. Yockey, Under Secretary of Defense for Acquisition, reinforces this message by passionately advocating the use of performance measurement (earned value) as a management tool. As the Keynote speaker at the 1991 C/SCSC National Workshop in Falls Church, Virginia, he asserted, "When program managers use this business management tool (earned value) properly, their programs will be both better planned and better executed and, therefore, ultimately much more successful." [Ref 1:p. 16]

Although major, or significant programs often overshadow non-major, or less than significant ones, non-major acquisitions share similar cost and schedule concerns. Given the declining defense budget, it is very likely that non-major acquisitions will make up a larger percentage of Department of Defense programs. Based upon the equipment successes of Desert Storm, Congress and DoD are motivating the military services to shift their resources and efforts to system upgrades vice system replacement. Undoubtedly, heightened Congressional/DoD interest and oversight will be placed upon cost and schedule control management of non-major programs.

B. RESEARCH OBJECTIVE

The objective of this research is to provide the reader with an understanding of the critical importance of cost and schedule management control in non-major DOD acquisitions. The research provides a comprehensive examination of the Cost/Schedule Status Report (C/SSR), including report rationale, report analysis, and the project manager's use in cost and schedule management. This thesis also examines changes in the C/SSR environment as a result of the Navy's A-12 Avenger Program termination, analyzes "lessons learned" from the termination, and provides the researcher's recommendations for future cost and schedule management improvement initiatives. In addition, the thesis analyzes the December 1991 proposed Cost/Schedule Status Report *Cost/Schedule Status Report Joint*

Guide revision. Contractor complaints of Government inconsistency in C/SSR application, changes in C/SSR application defined in *Department of Defense Instruction (DoDI) 5000.2*, and changes resulting from a December 1991 *Federal Acquisition Regulation* (FAR) clause detailing minimum provisions of a contractor cost and schedule management system prompted the proposed revision. The analysis will focus on how to retain adequate uniformity in reporting requirements while allowing the project manager flexibility to tailor requirements based on contract size and complexity.

C. RESEARCH QUESTIONS

The primary research question is:

"What should the project manager know to achieve cost and schedule control in non-major Department of Defense acquisitions and what affect has the Cost/Schedule Status Report had on cost and schedule performance?"

The following subsidiary questions are:

1. What are the key aspects of the DoD Cost/Schedule Status Report (C/SSR)?
2. How does non-major acquisition cost/schedule management differ from major system acquisition cost/schedule management? How is it similar?
3. How does the project manager use the data provided in the Cost/Schedule Status Report?
4. How does the Government set an appropriate threshold to measure cost/schedule variance?
5. Since C/SSR does not require the evaluation or acceptance of a contractor's internal management procedures, what problems does this create?

6. What is meant by rebaselining and what effect does it have on C/SSR?

7. How should the C/SSR be changed to retain adequate uniformity in reporting requirements while allowing the project manager flexibility to tailor requirements based on contract size and complexity?

8. How has the Navy's A-12 program cancellation affected the C/SSR environment? Are there any applicable lessons learned?

D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

1. Scope

This thesis focuses on what a DoD non-major acquisition project manager needs to know about cost and schedule management. It accomplishes this goal by providing a comprehensive look at the Cost/Schedule Status Report (C/SSR) including examination of report rationale, report analysis, and report use in project management. It also focuses on the future direction of the C\SSR including options to retain uniformity in the *C/SSR Joint Guide*, while allowing the project manager flexibility to tailor requirements based on individual project scope and complexity.

2. Limitations

This thesis limits its scope to C/SSR application in non-major acquisitions. As for application to sub-contracts in major system acquisitions, prime contractors usually review sub-contractor C/SSR information and incorporate it within the major system's Cost Performance Report.

3. Assumptions

This paper assumes that, although a major program is larger in dollar value and scope, non-major programs share many similar issues and problems in cost and schedule management. Also, to avoid confusion with the manner non-major and major projects/programs, and significant and less than significant projects/programs are addressed within DoDD 5000.1, DoDI 5000.2, and *The C/SSR Joint Guide*, the term non-major project/program will be used synonymously with the term less than significant project/program. In addition, the term rebaselining refers to contractor replanning or reprogramming actions.

E. METHODOLOGY

The research foundation of this thesis is the current *Cost/Schedule Status Report Joint Guide* that provides Department of Defense guidelines for cost/schedule management of non-major acquisitions [Ref. 2]. Government reports, directives, instructions, textbooks, and periodicals were also used as information sources. The 1991 proposed *Cost/Schedule Status Report Joint Guide* was used for thesis analysis. Defense Logistics Studies Information Exchange (DLSIE) and Defense Technical Information Center (DTIC) searches also provided the author a broad base of information.

The research base also includes interviews with numerous Government and industry personnel involved in various aspects

of the Cost/Schedule Status Report. Personal interviews were conducted with engineers and analysts from Defense Contract Management Area Operations (DCMAO) in San Bruno and Sunnyvale, California to gain a perspective of DCMAO's role in cost and schedule surveillance. Several Administrative Contracting Officers (ACO) were also interviewed to gain an understanding of their role in cost and schedule management.

Personal interviews were also conducted with senior service and Department of Defense staff personnel during a thesis trip to Washington, District of Columbia, and Wright Patterson Air Force Base, Ohio. Those interviewed included Performance Measurement Joint Executive Group (PMJEG) representatives from the Army, Navy, Defense Systems Management College, and the Office of the Secretary of Defense (Acquisition). These interviews provided a perspective of current policy issues concerning the Cost/Schedule Status Report. In addition, interviews with professors at the Defense Systems Management College, the Air Force Institute of Technology, and a member of the Office of the Secretary of Defense for Acquisition staff provided insight into cost and schedule training programs available within the Department of Defense.

Interviews were also conducted with project managers and/or staff representatives from the Army Communication and Electronics Command (CECOM), the Army Missile Command (MICOM), the Air Force Laboratory Command, and the Defense Nuclear Agency to gain an understanding of the use of the C/SSR within the PM

office. In addition, the author obtained information and insight on the various aspects of cost and schedule management through attendance at the 1991 C/SCSC National Workshop. This forum exposed the author to a diverse group of cost and schedule management professionals from the various military services, industry, Department of Defense Staff, the Performance Management Association, the National Security Industrial Association, and the Society of Cost Estimating and Analysis.

F. DEFINITIONS AND ABBREVIATIONS

Pertinent definitions are included in Appendix A. Abbreviations are included in Appendix B.

G. ORGANIZATION OF THE STUDY

This thesis consists of seven chapters. Chapter I is a general introduction presenting research questions, objectives, and methodology. Chapter I also includes a thesis chapter outline. Chapter II discusses the history and background of the Cost/Schedule Status Report, highlights key aspects of the report, and describes key differences between the Cost/Schedule Status Report and the Cost Performance Report used for major programs. Chapter III discusses Cost/Schedule Status Report implementation. Chapter IV examines report analysis and how the project manager uses report information and trend analysis to support management decisions. Chapter V analyzes how the Navy's A-12 Avenger

program termination has impacted the C/SSR environment. This chapter also provides cost and schedule management "lessons learned" from the A-12 and researcher recommendations for future improvement initiatives. Chapter VI explores current controversy in the proposed *Cost/Schedule Status Report Joint Guide* revision and provides the researcher's recommendations for C/SSR improvement. Chapter VII presents a thesis summary, conclusions, answers, and findings to thesis questions, researcher recommendations, and suggested areas for future research.

II. FUNDAMENTALS OF THE COST/SCHEDULE STATUS REPORT

A. HISTORY/BACKGROUND

Cost and schedule management of non-major programs has been an evolving process within the Department of Defense for over thirty years. It originated in the late 1950's with the development of the Program Evaluation and Review Technique (PERT). The increased complexity of weapons systems prompted the need for a management tool to track project progress. The Navy, therefore, developed PERT as a scheduling technique to manage their Polaris Fleet Ballistic Missile System. PERT provided the capability to display graphically the interrelationships of specific program activities. This enabled the project manager to focus on the planning and progress of upcoming critical activities in the schedule. A subsequent upgrade to PERT called PERT Cost added the capability to budget and report costs by PERT network activities. [Ref. 3:pp. 13-14]

Unfortunately, PERT and PERT Cost reporting requirements were often negotiated into contracts on top of valid, existing contractor management and control systems. This led to redundant contractor effort, and increased overhead expenses. Also, since the reports were not derived from the contractor's actual management control system, they did not accurately reflect current project status. [Ref. 3:p. 14]

In 1963, the Air Force Minuteman Missile Program Office, together with the Performance Technology Corporation, developed the earned value concept. Earned value provided the capability to measure the work actually accomplished in terms of the budget planned for that work. This system specified the general capabilities required of a contractor's internal management system, instead of requiring a specific, detailed Government system. To ensure these capabilities were met, the Government conducted on-site reviews and validations of a contractor's internal management system. [Ref. 3:p. 14]

During the early 1960's, a group within the Office of the Secretary of the Air Force was also working on a set of simplified standards to measure a contractor's internal management system. This approach contained the essential elements of the PERT Cost and earned value systems, but avoided detailed PERT cost reporting. In 1966, these standards emerged into the "Cost/Schedule and Control Specification" and became the cornerstone of Air Force project management. [Ref. 3:p. 14]

In December 1967, the Assistant Secretary of Defense (Comptroller) published DoD Instruction 7000.2, *Performance Measurement for Selected Acquisitions*. This instruction incorporated the basic tenets of the Air Force "Cost/Schedule and Control Specification." It included 35 Cost/Schedule Systems Criteria (C/SCSC) to be imposed on contractor internal management systems to ensure reliable, integrated cost and

schedule management. It also established a standard requirement for cost and schedule performance measurement throughout the Department of Defense. In August 1970, the *C/SCSC Joint Implementation Guide* was published to provide further, more detailed guidance on earned value and how it should be implemented within DoD.

Unfortunately, the Cost/Schedule Systems Criteria and *C/SCSC Joint Implementation Guide* were not well suited for smaller, non-major (less significant) projects. PMs of non-major programs were expected to implement the C/SCSC system less rigorously [Ref. 2: p. 1-1]. The program manager was expected to use his experience and assessment of the contractor risk, scope of work, and other factors to evaluate the level of implementation. This vague guidance resulted in inconsistent application of the criteria. "Furthermore, the lack of standard formats for contractor cost/schedule reporting on non-major contracts led to a proliferation of contract-unique reports, to the use of out-dated reports and to the application of cost/schedule control system and reporting requirements, which had been designed for large contracts, to smaller and smaller contracts [Ref. 2:p. 1-1]." As a result, DOD Instruction 7000.10, *Contractor Cost Performance, Funds Status and Cost/Schedule Status Reports*, was published in August 1974. Department of Defense Instruction 7000.10 established the Cost/Schedule Status Report (C/SSR) as the standard for reporting summarized cost/schedule performance on

non-major acquisitions. Also, in 1978, the *C/SSR Joint Guide* was published to provide more detailed, uniform guidance on the Cost/Schedule Status Report and the management of non-major contracts. According to the 1978, *C/SSR Joint Guide*, a non-major contract was considered a development contract under $25 million dollars or a production contract under $100 million dollars [Ref. 2: p. 1-1]. These dollar values associated with application of the C/SSR were adjusted in 1987, as specified in DoD Directive 5000.1, *Major and Non-Major Defense Acquisition Programs*. According to DoDD 5000.1, a non-major contract was considered one in which DoD Cost/Schedule Control Systems Criteria was not required; usually development contracts under $40 million dollars or production contracts under $160 million dollars [Ref. 4:p. 1].

In 1988, Mr. Costello, the Under Secretary of Defense for Acquisition (USD(A)), initiated a review of acquisition policy and procedures. Subsequently, a Defense Management Review Team formed to identify recommendations for streamlining and disciplining the acquisition system. Mr. Betti, Mr. Costello's successor as USD(A) continued this effort by initiating a task force. [Ref. 5] These efforts resulted in the February 1991 publication of Department of Defense Instruction (DoDI) 5000.2, ***Defense Acquisition Management Policies and Procedures***, replacing DoDI Instruction 7000.2. Department of Defense Instruction 5000.2 is currently implemented throughout DoD. This document redefined the guidance

on the application of the C/SSR. According to DoDI 5000.2, the Cost/Schedule Status Report will now be used on contracts that are not significant enough for cost/schedule systems criteria application [Ref. 6: p. 11-B-3, para. 2d]. A non-significant *or* less than significant contract is a research, development, test and evaluation contract with a value of less than $60 million, or a procurement contract with a value of less than $250 million (in fiscal year 1990 constant dollars) [Ref. 6: p. 11-B-2, para 2b. (2)].

Exceptions to cost/schedule status reporting authorized by DoDI 5000.2 include contracts that are firm fixed price (including firm fixed price contracts with economic price adjustment provisions), time and materials contracts, and contracts that consist mostly of level of effort work [Ref. 6:p. 11-B-2, para. 2c]. Department of Defense Manual 5000.2M, *Defense Acquisition Management Documentation and Reports*, further specifies the use of the C/SSR as "...to obtain contract cost and schedule performance information on contracts over 12 months in duration where application of the Cost Performance Report is not appropriate." [Ref. 7: p. 20-8, para. c] Although the manual does not establish a specific dollar minimum, it suggests that application of the C/SSR to contracts less than $5 million (constant fiscal year 1990 dollars) should be carefully evaluated to ensure that only the minimum information necessary for effective management control is required.

The 7 January 1991 cancellation of the Navy's A-12 Avenger aircraft by the Secretary of Defense, Mr. Cheney, due to severe cost and schedule problems, has reinforced the requirement for effective cost and schedule management within the Department of Defense. This emphasis is strengthened by the current USD(A), Mr. Don Yockey, who advocates the use of earned value procedures as an essential part of any PM early warning system [Ref. 1]. These factors, combined with a shrinking defense budget, will ensure that cost and schedule performance management remain a crucial aspect of DoD project management.

B. OBJECTIVES OF THE COST/SCHEDULE STATUS REPORT

The C/SSR provides the Government project manager with summary level cost/schedule performance status information, normally monthly, for early identification of the magnitude and impact of problems having significant cost variances; effects of management actions taken to resolve existing problems; and contract status information for use in decision-making [Ref. 8: p. 3-2]. It identifies those work breakdown structure elements responsible for cost and schedule problems and provides trend information to estimate final project costs. It is a less extensive, more flexible, management report, more appropriate for less than significant acquisitions. The C/SSR gives contractors flexibility in their internal management operations by avoiding the imposition of

specific systems or changes to their existing systems. In addition, the basic objectives of the C/SSR are to:

1. Provide for effective management of non-major (or less than significant) contracts, especially those that are critical or high risk.

2. Provide for objective, integrated cost/schedule performance reporting on these contracts.

3. Standardize cost and schedule performance reporting on these contracts.

4. Provide compatible cost and schedule performance data with that generated on significant contracts. [Ref. 2:p. 1-2]

C. KEY ASPECTS OF THE COST/SCHEDULE STATUS REPORT

The Cost/Schedule Status Report consists of four parts: contract report administrative information, contract data, performance data, and narrative explanations. The short administrative section includes information on the contract type, project name, contractor name and location, report period, and signature of the contractor's authorized representative who prepared the report itself.

The contract data section establishes the overall contract value. This value serves as a cost baseline for the purposes of cost performance measurement. Items included in this section are:

1. The Original Contract Target Cost- The dollar value (excluding fee or profit) negotiated in the original contract.

2. Negotiated Contract Changes- The cumulative cost (excluding fee or profit) applicable to definitive contract changes that have occurred since the beginning of the contract.

3. Current Target Cost- This figure is the sum of the original contract target cost and the negotiated contract changes.

4. Estimated Cost of Authorized, Unpriced Work- Estimated cost (excluding fee or profit) for contract changes that have written authorization, but are still unpriced.

5. Contract Budget Base- This figure is the sum of the current target cost and the estimate of authorized, unpriced work. [Ref. 2: pp. E2-E3]

The performance data section on the C/SSR depicts contract cost status for the specified cost work breakdown structure elements on a cumulative basis and as estimated at completion. [Ref. 2: p. 4-1]. Cost, schedule, and estimate at completion variances in exceeding previously established thresholds need to be fully explained in the contractor's narrative comments. Items included in this section are:

1. Work Breakdown Structure Element- This column contains the various contract work breakdown structure (WBS) elements for the contract. The level of work breakdown reporting is usually specified in the contract as level 3 or higher performance measurement.

2. Budgeted Cost of Work Scheduled- This is the value of all work scheduled to be accomplished as of the reporting cut-off date listed by each WBS element.

3. Budgeted Cost of Work Performed- This is the value of all work accomplished as of the reporting cut-off date listed by each WBS element.

4. Actual Cost of Work Performed- This is the cumulative actual costs (direct and indirect) of work accomplished as of the reporting cut-off date listed by each WBS element.

5. Schedule Variance- This is the difference between the Budgeted Cost for Work Scheduled and the Budgeted Cost for Work Performed. A negative figure indicates an unfavorable variance and is shown in parentheses.

6. Cost Variance- This is the difference between the Budgeted Cost of Work Performed and the Actual Cost of Work Performed. A negative figure indicates an unfavorable variance.

7. At Completion-Budgeted- This is the total budget identified to each WBS element (including any contract changes, application of management reserve, or internal replanning).

8. Latest Revised Estimate- This is the contractor's latest revised estimate of cost at completion including estimated overruns or underruns for all authorized work. This figure consists of the total dollar value of work to date plus the estimate of cost for work remaining listed by WBS element.

9. At Completion-Variance- This is the difference between the Budgeted Cost at Completion and the Latest Revised Estimate.

10. General and Administrative (G&A)- These figures represent the total G&A costs applicable to items (2) through (9).

11. Undistributed Budget- These figures represent the amount of budget applicable to authorized contract effort that is not identified to WBS elements at or below the reporting level. It is listed separately under the columns At Completion-Budgeted and Latest Revised Estimate.

12. Management Reserve- This figure is the amount of budget identified as management reserve as of the end of the reporting period. It is listed under the column At Completion-Budgeted as the amount of management reserve expected to be consumed before the end of the contract. The variance of planned management reserve versus forecasted management reserve is listed under the column At Completion-Variance.

13. Totals- Totals of all cumulative to date and at completion information are shown at the bottom of the report. [Ref. 2:pp. E3-E4]

Narrative explanations are included as a separate portion of the Cost/Schedule Status Report when work breakdown structure variances exceed established thresholds. All

contractor explanations provided should be complete and include details concerning the nature of the problem, variance impact, and any corrective actions taken. The Government project manager should carefully review these explanations and track corrective actions. Often the Government project manager accomplishes this follow-up with the contractor project manager through routine telephone communications and/or meetings.

D. DIFFERENCES BETWEEN THE COST/SCHEDULE STATUS REPORT AND THE COST PERFORMANCE REPORT

Although the Cost/Schedule Status Report and Cost Performance Report (CPR) (specified for significant acquisitions) both provide important cost and schedule visibility needed for effective project management, there are some fundamental differences in the two reports. First, the C/SSR report consists of only two formats, or sections, as compared to the five formats included in the CPR. The C/SSR has a format similar to format one of the CPR but contains only cumulative data (from contract award to present), vice current period data required by the CPR. The C/SSR also does not require functional performance reporting, manloading projections, and baseline reporting, associated with formats two, three, and four of the CPR. Both reports, however, share a similar format five, which contains a contractor narrative of overall contract performance, explanations for significant variances,

and identification of problems and recommended corrective actions.

The C/SSR and CPR also contain important differences in the manner in which the budgeted cost of work scheduled (BCWS) and budgeted cost of work performed (BCWP) are derived. These are both key factors used in the calculation of schedule and cost variances for the project. The CPR requires BCWS and BCWP to be calculated as a direct summation of work package budgets. The C/SSR permits the determination of these values through any reasonably accurate, consistent, and mutually agreed to means. This provides the contractor maximum use of existing internal management control systems, and greater flexibility in the selection of an internal performance measurement technique.

Finally, the C/SSR does not require a formal Government validation of a contractor's internal cost and schedule management system. Instead, it requires only a contractor plant visit by selected representatives from the Government project management (PM) and contract administration offices. Both the plant visit and the validation, however, have similar goals of ensuring that the contractor uses consistent and objective measures for collecting and reporting cost and schedule information.

These differences between the Cost Performance Report and Cost/Schedule Status Report allow the C/SSR to be a flexible, less demanding requirement, and therefore, a less costly

contract data requirements list (CDRL) item. It is just as important, however, for the non-major system project manager to understand the fundamentals of cost and schedule management, to effectively utilize C/SSR information for decision making.

E. KEY PLAYERS IN COST AND SCHEDULE MANAGEMENT OF NON-MAJOR PROGRAMS

There are several key players who support the PM in project cost and schedule management. These players include the project or matrix assigned cost analyst, the Defense Contract Audit Agency (DCAA) auditor, Defense Contract Management Area Operations (DCMAO) personnel, and the Administrative Contracting Officer (ACO). Collectively, these players provide the PM with an array of administrative services, contractor data analysis, contractor surveillance, and contractor performance evaluation.

The matrix assigned cost analyst reviews and analyzes the C/SSR information. He also provides the project manager with a cost and schedule trend projection, including a forecast for the total cost of the project at completion. Depending on the size of the project, the business/financial cost analyst may be organic to the PM office. Usually, however, this analyst is part of a matrix support organization within a major systems command.

The Defense Contract Audit Agency auditor provides the PM with periodic evaluations of the contractor's C/SSR data and his accounting records. The auditor also provides an independent analysis of the contractor's performance to the Administrative Contracting Officer (ACO), upon his request. Included in his analysis is an Estimate at Completion (EAC). The EAC is the sum of all actual direct and allowable indirect contract costs, plus an estimate of cost for authorized work remaining.

The Defense Contract Management Area Operations (DCMAO) organization provides contract administrative services for the non-major system project manager. Unlike major systems, which are usually assigned a dedicated Defense Plant Representative Office (DPRO), non-major projects receive support from the DCMAO office located closest to the contractor. This operation contains two divisions whose responsibilities include cost and schedule control management. These two divisions are the Program and Technical Support Division and the Contract Management Division.

The Program and Technical Support Division consists of three branches; the Systems Engineering Branch, the Manufacturing Branch, and the Program Support Branch. The Systems Engineering Branch and the Manufacturing Branch assess contractor cost, schedule, and technical performance compliance according to the contract. Another key function performed is the review and evaluation of contractor engineering

change proposals with regard to cost, schedule, and technical performance impact. [Ref. 9: Chptr 6, Part V, pp. V-6-2 through V-6-6]

The Program Support Branch performs an independent analysis and assessment of the C/SSR information, coordinates on site reviews of the contractor, and conducts contractor surveillance [Ref. 9: Chptr 6, Part V, p. V-6-3]. This independent analysis is provided to the Administrative Contracting Officer for use in his evaluation of progress payments. The Program Support Branch can also provide their independent analysis and assessment to the project manager. This independent analysis and assessment provides the PM with another perspective of project performance.

The Contracts Management Division provides contract administration, contract evaluation, contract negotiation or discussion, and cost, price and financial analysis [Ref. 9: Chptr. 6, p. VI-3-3]. The Administrative Contracting Officer is assigned to this division and reviews, approves or disapproves contractor requests for progress payments. If necessary, he can suspend progress payments, given unsatisfactory contractor work progress. In addition, he monitors the contractor's accounting system and performance throughout the life of the contract.

On a final note, because the DCMAO is often located close to the contractor plant, it is an excellent position to give the PM timely visibility of contractor contract performance.

The DCMAO can investigate cost and schedule problems first hand. This is particularly useful to a non-major program because of limited organic personnel and/or funds for contractor visits.

F. CHAPTER SUMMARY

This chapter provided the reader with the history of cost and schedule management, and an understanding of the origin of the C/SSR. It also detailed the objectives of the C/SSR, defined its application, and introduced key aspects of the report. Differences between the C/SSR and the CPR were discussed to further inform the reader. Finally, the chapter outlined the responsibilities of various Department of Defense agencies and personnel in cost and schedule management, and described the support they provide to the project manager.

Chapter III will build upon the information provided in Chapter II. It will discuss C/SSR implementation and its importance to cost and schedule management. The chapter will also detail actions the PM should take or monitor to ensure good initial project management. Finally, Chapter III will discuss baseline establishment and maintenance, and its importance to the C/SSR.

III. C/SSR IMPLEMENTATION

A. CHAPTER INTRODUCTION

This chapter will provide the reader with an understanding of the important role the implementation process plays in cost and schedule management. It will describe management actions that should be taken during the non-major contract preaward process to ensure adequate initial cost and schedule management and valid C/SSR information. These actions include careful solicitation preparation and the establishment of appropriate thresholds by the project manager to measure cost and schedule variances. The chapter will also discuss the establishment and maintenance of the performance measurement baseline. Finally, the chapter will discuss contractor plant visits, and the role the DCMAO plays in cost and schedule surveillance monitoring.

B. C/SSR IMPLEMENTATION: THE IMPORTANCE OF THE PREAWARD PROCESS

Management involvement and careful PM attention during the preaward process cannot be overemphasized. This phase of C/SSR implementation is key to project cost and schedule management. Decisions made during preaward impact the manner, frequency, and level of cost and schedule data reporting during contract execution.

The need for management attention during preaward was reinforced by the findings of the May 1991 Joint DoD/Industry Total Quality Management (TQM) Team. This team performed a comprehensive review of the cost/schedule management process within DoD and industry. The team identified the preaward prcess as "the most important area in need of process improvement" [Ref. 10:p. 3.3-1]. Among the recommendations made by the TQM team were, "Participants in the preaward acquisition process should increase their efforts to ensure adequate and reasonable cost/schedule reporting requirements" [Ref. 10: p. 3.3-12]. Thus, it is critical for the non-major acquisition project manager to understand how preaward management activities and decisions impact project cost and schedule reporting.

C. C/SSR IMPLEMENTATION: PREAWARD

The preaward process begins with the preparation and issuance of the Government's request for proposal (RFP) to prospective contractors. Included in the RFP is the statement of work (SOW) which details Government requirements. It is important for the SOW to clearly define the Government's needs to avoid confusion in work requirements. The SOW must accurately reflect the actual Government requirement, stating adequately "what" is to be done without describing how [Ref. 20: P. 16].

It is important for a SOW to be carefully prepared by the Government in clear and concise language. While a good SOW

will not save bad management, a poor SOW will create problems during project execution [Ref. 20: p. 22]. A poorly written statement of work can also result in excessive project costs through subsequent contract changes.

The requirement for contractor submission of the Cost/Schedule Status Report is specified by the Government in the contract request for proposal. The C/SSR is specified as Data Item Description DI-F-6010 in the Contract Data Requirements List (CDRL) of the RFP. In addition, the Defense Federal Acquistion Regulation Supplement (DFARS) prescribes the use of DFARS clause 252.242-7005 in the solicitation.

This DFARS clause outlines specific contractor responsibilities to be used in the execution of cost and schedule management. It requires a prospective contractor to either submit a written summary of the management procedures it will establish, maintain, and use in planning and controlling costs, measuring performance, and generating timely and reliable C/SSR information, or to submit a Memorandum of Understanding indicating previous C/SCSC validation. The clause also describes minimum requirements for a contractor's cost and schedule management system and outlines subcontractor reporting. It provides for Government Contracting Officer access to all pertinent contractor records, procedures, and cost and schedule data. Finally, it specifies the requirement for the Contracting Officer or designated representative to visit the contractor's plant to verify cost and schedule

management procedures, and requires the contractor to submit substantive changes to his management procedures to the Contracting Officer for review. [Ref. 21 pp. 252.242-7, 252.242-8].

The Government also specifies C/SSR reporting frequency in the RFP. Generally, a monthly reporting frequency is established initially by the Government project manager. Provisions are often included to relax report frequency if the project progresses well, and the PM determines this can be accomplished without detrimental management risk.

Also included in the solicitation is a preliminary summary level (levels one, two, and three) project work breakdown structure (WBS) organized by product structure (as opposed to functional organization). The WBS is a family tree division of hardware, software, services and project tasks which organizes, defines, and graphically displays the product to be produced (as specified in the SOW), as well as the work to be accomplished to achieve the specified product. This preliminary work breakdown structure is prepared by the project office using guidance outlined in MIL-STD 881, Work Breakdown Structure for Defense Material Items. It should be representative of the statement of work.

The project manager should also specify the level of the work breakdown required for cost and schedule reporting. In order to keep reporting requirements reasonable, while maintaining adequate management detail, C/SSR requirements

should generally be limited to level three or higher (summary level) of the contract work breakdown structure. This will provide for performance reporting for about 20 to 30 elements. Sometimes, however, based on the project manager's risk assessment, certain high risk elements may be identified for more detailed, lower level reporting.

Below level three, the contractor should have full flexibility on how the work breakdown structure is organized, as long as it still reflects product orientation and establishes clear accountability and responsibility for each piece of work [Ref. 11]. Contractors will structure their lower WBS levels to reflect their management needs for planning and control. The lowest level of the extended contract WBS, therefore, will reflect a level of detail appropriate for the contractor's management and cost accounting system.

D. C/SSR IMPLEMENTATION: THRESHOLD ESTABLISHMENT

Variance thresholds should also be set forth in the Government's request for proposal. Variance thresholds establish control limits for cost or schedule variances. The contractor submits narrative explanations in the C/SSR for all variances exceeding thresholds. Cost variances are listed for each work breakdown structure element in column five of the C/SSR. Schedule variances are listed for each WBS element in column six of the C/SSR.

Thresholds are established by the project manager. It is important for the project manager to carefully assess his threshold requirement to maintain adequate problem visibility. Variance thresholds set too low (one to five percent of costs), could result in voluminous narrative reporting, innundating the PM with minor problems. However, variance thresholds set too high (costs greater than 20 percent) could result in a lack of early management visibility of significant problems. There are several approaches that can be used by the project manager to determine appropriate variance thresholds. In many contracts, thresholds are established requiring a variance analysis for any cost or schedule variance that exceeds a certain percentage of BCWS or BCWP and/or exceeds an established dollar minimum. The project manager should consider aspects such as contract risks and contract size when choosing a threshold percentage and dollar minimum.

A simple approach sometimes used in variance threshold establishment is for the PM to establish a fixed number of variances for the contractor to report [Ref. 12]. For example, the PM could require the contractor to report the ten greatest (by dollar value or by percentage) cost or schedule variances. This approach ensures that the project manager is receiving a manageable amount of contractor narrative explanations, while ensuring visibility over the most important project problems. The Air Force's Space Systems Division has applied this approach with reasonable success [Ref. 11]. The

National Security Agency also frequently uses this method in threshold establishment [Ref. 23].

Another approach is for the PM to specify narrative reporting for only high cost and/or schedule critical items which exceed thresholds [Ref. 2: p. 3-2]. Risk analysis could be used to determine these critical cost or schedule drivers. This approach requires good communication between the Government PM and the contractor to ensure appropriate items are reported. One variation to this approach is to set lower thresholds on critical items and higher thresholds for less critical items. This allows critical items to be monitored closely, while allowing management visibility on all significant variances.

Regardless of approach, the PM should include in his request for proposal a requirement for periodic variance threshold reviews. A reasonable time frame for the review is every six months [Ref. 13]. This review requirement provides the PM the flexibility to adjust thresholds, if necessary, based on management information needs [Ref. 12]. It also allows the PM to tighten thresholds, if required, as the project progresses. As recommended by one experienced civilian project manager, "As you start a project, thresholds can be more broad since you have more time to correct problems, however, narrow thresholds should be established toward the end of a project" [Ref. 14].

E. C/SSR IMPLEMENTATION: PREAWARD CONTRACTOR ACTIONS

Upon receipt of a Government request for proposal, a prospective contractor will review the statement of work. The contractor uses the SOW as a basis for preliminary cost and schedule planning. The contractor identifies and allocates resources based on his assessment of the scope of specified work. Preliminary schedules are developed and resources are time phased with the appropriate labor, material, overhead, and general and administrative (G&A) costs [Ref. 17, p. 1]. Cost estimates developed during this process form the basis of the contractor's bid or price.

The contractor's proposal must also explain internal cost and schedule management practices used by the firm, as required by DFARS clause number 252.242-7005. This explanation will include a description of how cost and schedule management will be accomplished and C/SSR data requirements met. This will facilitate Government evaluation of how the contractor's internal cost/schedule planning and control activities generate report data [Ref. 15: p. 2-3]. In addition, the contractor should also include any recommended changes and additions to the summary work breakdown structure.

F. C/SSR IMPLEMENTATION: NEGOTIATIONS/DISCUSSIONS, PROPOSAL EVALUATION

During contract negotiations or discussions between the Government and a prospective contractor, a target price and

target cost are established. In a cost plus fixed fee contract, an agreed upon estimated contract cost and price is established. A contract target price or estimated contract price is the total cost of contract work including profit or fee, while a contract target cost or estimated cost excludes profit or fee [Ref.6: p. 11-B-2-2]. The contract target cost, or estimated cost, will become the base figure the contractor will use to develop the contract's performance measurement baseline. The performance measurement baseline is the time phased budget plan against which project performance is measured.

During negotiations or discussions, the contract work breakdown structure is also finalized. Details of cost and schedule reporting are also negotiated or discussed, including initial and subsequent report submission dates. It is important for the PM to ensure that a prospective contractor fully understands cost/schedule status report requirements to reduce the potential for reporting problems during contract execution.

During proposal evaluation, Government source selection board representatives must consider the technical, schedule, operational readiness and support, and financial risks inherent in a proposal [Ref. 6:p. 10-B-9]. The evaluators must make an assessment of the contractor's proposed price and schedule. They evaluate the realism of the contractor's proposal, relative to Government cost estimates [Ref. 6:p. 10-

B-9]. A proposal which is assessed as underbid, or unrealistic, has the potential for increased cost and schedule problems during contract execution. This situation, typically referred to as a contractor "buy-in," should be avoided.

A "buy in" may also result in contract front-loading. Front-loading is an attempt by a contractor to provide adequate budget in the near-term budget baseline, at the expense of far-term effort. A contractor who intentially front-loads his budget, delays visibility of a potential contract overrun. The contractor hopes that contract changes will be sufficient to avoid an eventual contract overrun [Ref. 16:p. 209]. A related condition which can occur, particularly with "buy-ins" is "rubber baselining." Rubber baselining is when a contractor shifts allocated down-stream budget forward into the current period to cover current cost problems. Similar to front-loading, rubber baselining delays visibility of a likely contract overrun.

G. ESTABLISHMENT OF THE PERFORMANCE MEASUREMENT BASELINE

Upon contract award, the contractor will establish a management reserve. The management reserve is the portion of the contract budget base that is held for management control purposes by the contractor to cover contingencies, or unanticipated program requirements. It is not a part of the performance measurement baseline [Ref 16:p. 94]. The amount of management reserve allocated is based on the contract project

manager's perceived contract risk, prior experience, and project length. Generally, the higher the technical risk, the higher percent of cost is allocated to management reserve. Also, since smaller projects typically have shorter time spans and less time to react to problems, a higher management reserve is often allocated [Ref. 14]. Typically, the management reserve will range between eight and 12 percent of the target cost [Ref. 16:p. 3].

After determination of a management reserve, the contractor will develop the project schedule. The schedule is tailored to support contract requirements and should reflect the WBS structure [Ref. 22:p. 11]. The contractor schedules tasks down to the cost account level, within the framework of project milestones [Ref. 16:p. 95]. The cost account level is the point where the functional responsibility for the work is assigned. It represents the work assigned to one responsible organizational element, on one contract work breakdown structure element [11-B-2-2].

Once a contractor has established the project schedule, he allocates his budget (minus management reserve) down to the cost account levels, consistent with the work specified for each cost account task [Ref 16, p. 95]. Cost accounts are further subdivided into work packages for more detailed budget control. Work packages are detailed short span jobs, or material items which have assigned budgets for accomplishing the work required to complete the contract [Ref. 19: p.3].

Work package costs are summarized at the cost account level for performance reporting by the cost account manager.

This time-phased budget plan forms the performance measurement baseline against which project performance is measured. Actuals for each cost account are compared to budgeted values to assess project cost and schedule performance. These actual and budgeted values are summarized to the level specified in the contract for inclusion in the Cost/Schedule Status Report.

Performance measurement baseline establishment is essential to cost and schedule management. As emphasised by a Defense Systems Management College (DSMC) Cost and Schedule Management Professor, "If you start out with an unreasonable baseline, you start off wrong right off the bat" [Ref 11]. Baseline establishment forces the contractor to carefully plan the entire scope of work [Ref. 18: p. 1]. Thus, a contractor should have a realistic budget and a good performance measurement baseline established as soon as possible after contract award.

While it may not be possible to plan the entire work effort in detail at the outset of the contract, budgets must be set aside for the accomplishment of the future activity. A contractor should have a detailed baseline developed for all near term work down to the cost account level and the remaining work planned at a summary level. Six months is often used as a general definition of near term work, although a shorter span of time is sometimes used for technically complex

contracts. As stated by an experienced civilian project manager, "Good initial planning pays dividends later on in a project" [Ref. 14].

Failure to have a detailed performance measurement baseline established for near term work causes the project manager to lose early, accurate performance visibility. This early performance visibility is particularly important with smaller and often shorter contracts associated with Cost/Schedule Status Reporting, as several months of poor performance visibility could easily represent up to 25 percent of contract work completion for a one year contract. Yet, according to an OSD Program Analyst, it is a problem getting the contractor on-line with an early, solid performance baseline and initial, valid cost and schedule management reporting [Ref. 6].

Thus, it is important for the Government PM to insist that the contractor establish a detailed baseline soon after contract award. There are several means to this end. First, the Government could link the establishment of a performance baseline to a contract performance review [ref 11]. This approach ensures that PM attention is focused on baseline establishment, and forces the contractor to formally brief the Government PM on his baseline. Another approach is to tie progress payments to performance baseline establishment. This approach provides an incentive for the contractor to establish his performance measurement baseline in a timely manner.

Once the performance measurement baseline is established, it is equally important to maintain its integrity. This requires particular discipline on the part of the contractor, as contract changes, funding changes, technical problems, or other unforeseen difficulties will typically require rebaselining and/or changing the contract target cost or estimated cost. Without tight discipline of changes, any established baseline will be lost [Ref 16]. Any changes made to the baseline should be traceable to the contract change and incorporated in a timely manner. The contractor's scheduling and budgeting systems must be formal and disciplined, to prevent inadvertent or arbitrary budget or schedule changes. As stated by a senior DoD cost analyst, "This does not mean that the baseline is static or inflexible, simply that changes must be controlled and result only from deliberate management actions [Ref. 18]". Many contractors, including Motorola, use internal project logs to formally record changes.

A contractor is, however, allowed to internally replan work as long as he stays within the total contract target cost or estimated cost, and completes all work by the contractual completion date [Ref. 16: p. 104]. A contractor, however, may not make retroactive changes to budgets or costs of completed work [Ref. 22: p. 37]. If work is later found to be sub-quality, the contractor must plan a new work package to correct work, as opposed to re-opening the old work package. Replanning that results in changes to budgets for reporting

level CWBS elements should be explained by the contractor in the C/SSR narrative [Ref. 15: p. 4-10].

H. CONTRACTOR PLANT VISIT

Project office, DCMAO, and DCAA representatives become familiar with the contractor's internal cost management system through a contractor plant visit. This visit is arranged through prior coordination with the contractor. The visit duration varies depending on the size of the contract and prior contractor experience with the C/SSR. Generally, plant visits last anywhere from a day to a week.

During the plant visit, Government representatives should achieve a basic understanding of the methods by which the contractor plans the work, controls project resources, evaluates project accomplishment, measures cost/schedule performance, collects costs, and incorporates contract changes into the baseline [Ref. 2:p. 2-7]. They should also review the contractor's performance measurement baseline, to ensure a valid PMB is in place. An understanding and assessment of these various aspects is gained through interviews with the contractor's project manager, contractor cost account managers, business financial managers, and other contractor plant personnel. Internal written contracting operating procedures are also reviewed.

Overall, a sense that cost and schedule management is an integral part of the contractor's project management, as

opposed to merely a Government reporting re- '-ement, should be obtained. A contractor's management ı/stem should be capable of generating timely and reliable information for the C/SSR. It is, therefore recommended that the Government project manager personally participate in the plant visit to emphasize his interest in cost and schedule management.

I. CONTRACTOR MEASUREMENT OF EARNED VALUE

During the plant visit, it is also important for the Government representatives to gain an understanding of the contractor's methodology for measuring earned value (budgeted cost of work performed). Since completed tasks are considered to have earned 100 percent of their BCWS, and tasks which have not started are considered to have earned 0 percent of their BCWS, they are easy to measure. The major difficulty encountered in the determination of BCWP is, therefore, evaluation of the in-process work [Ref. 16, p. 121]. In-process work represents work tasks that have started, but are not completed as of the reporting cut-off date.

The contractor's methodology for measuring earned value should be objective, and based on physical work accomplishment. There are essentially six distinct methods to measure budgeted cost of work performed (BCWP) as follows:

1. The 50/50 technique- This technique is sometimes utilized for work packages with a duration of two accounting periods. 50 percent of the planned value is earned when the activity starts, and the balance is earned when the effort is complete.

2. The 0/100 technique- This technique is best applied to those work packages which are scheduled to start and be completed within one accounting month. 0 percent is earned when the activity starts, but 100 percent is earned when the activity is completed.

3. Percent complete- This techniques allows for a monthly estimate of the percentage of work completed. This estimate should ideally be accomplished by the work project manager who is closest to the activity on-going. This technique can be subjective but can be made more objective with the establishment of guidelines by the civilian project manager for percent complete determination.

4. Milestone method- This technique works well when work packages exceed three or more months in duration. Objective milestones are established and the assigned budget for the work package is divided up based on a weighted value assigned to each milestone.

5. Equivalent and/or completed units- This technique is often used for manufacturing efforts. It places a given value on each unit completed or fractional equivalent as the basis for setting the budget value and earned value.

6. Earned standards- This complex technique is sometimes used for manufacturing efforts. It involves the prior establishment of standards (based on motion studies, historical performance, etc.) for the performance of the tasks to be worked. The work in progress is then evaluated based on these standards. [Ref. 7:pp. 122-124]

J. MEMORANDUM OF AGREEMENT

After contract award and prior to the start of contract work, the project manager should also establish a Memorandum of Agreement (MOA) with Defense Contract Management Area Operations Program and Technical Support personnel who are assigned as matrix support to provide contract administrative services for the project. An MOA will ensure DCMAO personnel clearly understand the extent of their C/SSR surveillance

responsibilities for the contract. It specifies any special PM requests including particular surveillance tasks, surveillance frequency, and the manner or format surveillance information is to be presented to the PM. As emphasised by one experienced PM, the DCMAO Program and Technical Support personnel should be managed and cultivated as an extention of the project management team [Ref. 24:p. 40].

Typical surveillance duties for Program and Technical Support personnel include monitoring C/SSR contract requirements, assuring that the contractor submits timely, reliable, and valid reports, and providing independent C/SSR analysis to the project manager. Other surveillance actions include the follow-up and monitoring of any contractor corrective actions, reconciliation of the C/SSR data to the contractor's internal data, monitoring the contract to ensure contractual requirements are met, and verification that contract changes are incorporated into the baseline in a timely manner [Ref 15. p. 2-12].

K. CHAPTER SUMMARY

This chapter provided the reader with an understanding of the importance of management involvement during the preaward process. It described the actions that should be taken to ensure good C/SSR implementation. It also discussed baseline establishment and maintenance, and its role in cost and schedule management. Finally, Chapter III described the

contractor plant visit, and the DCMAO's role in cost and schedule management surveillance.

Chapter IV will discuss C/SSR analysis, including earned value measurement, and data trend analysis. It will describe management actions that could be taken based on C/SSR data analysis. Finally, it will discuss reprogramming and its effect on cost and schedule management.

IV. COST/SCHEDULE STATUS REPORT ANALYSIS AND MANAGEMENT ACTIONS

A. CHAPTER INTRODUCTION

Chapter IV will provide the reader with the basic tools necessary for C/SSR analysis. It will discuss the importance of C/SSR analysis, and how it can be used for project cost and schedule management. Finally, the chapter will describe some management actions the PM can take if a contractor is over cost and behind schedule, including the affect reprogramming has on the C/SSR.

B. C/SSR ANALYSIS: PURPOSE

Cost/Schedule Status Report analysis provides valuable management information to the project manager. It provides the project manager with indications of project cost overruns and schedule slippage, enabling the PM to take timely corrective action. Report trend analysis allows the project manager to evaluate the effects of corrective actions by indicating whether cost and schedule variances are improving or getting worse. Report trend analysis also provides the project manager with a forecast of the estimated cost of the project at completion. This forecast provides the PM with an early indication of a future project overrun. Thus, it is important for the project manager to understand some basic

tools and techniques used in C/SSR analysis, and to understand how this information can be used in project management decisions.

C. PERFORMANCE FACTORS

Several basic cost and schedule performance factors are included directly as entries within the contractor's Cost/Schedule Status Report. Cost variance, which equals the Budgeted Cost of Work Performed (BCWP) minus the Actual Cost of Work Performed (ACWP), is indicated in column six of the report for each work breakdown structure element. The cost variance is summarized for the project at the bottom of column six. A positive cost variance shows a favorable cost status (underrun), while a negative cost variance shows an overrun.

Schedule variance, which equals the Budgeted Cost of Work Performed (BCWP) minus the Budgeted Cost of Work Scheduled (BCWS), is indicated in column five of the report by work breakdown structure element. It is summarized at the bottom of column five. The schedule variance is an indication of whether work is accomplished as planned. A positive schedule variance shows that work is ahead of schedule, while a negative schedule variance shows work slippage. This can be equated to time (days, months, etc.) by graphically comparing the cumulative BCWP to the BCWS. It is important to remember that a schedule variance is really a measure of in-process work only. Work that has not started and work that is

complete has no schedule variance. This makes the schedule variance valuable as a performance indicator early in project execution [Ref 26]. Often, schedule variances indicate the first signs of project trouble.

Cost and schedule variances exceeding established management threshold parameters must be explained in the contractor narrative. They should be reviewed by the project manager, and followed-up with the contractor, if necessary. Although a proactive project manager will likely not be surprised by the written explanation provided by the contractor for a cost or schedule variance because of frequent communication between himself and the contractor's PM, the narrative section does provide an official written explanation of problems and contractor proposed actions.

D. THE COST PERFORMANCE INDEX, TO COMPLETE PERFORMANCE INDEX, AND THE SCHEDULE PERFORMANCE INDEX

A Cost Performance Index (CPI), calculated from C/SSR information, provides the project manager an indication of project cost efficiency. It is a ratio of accomplishment to incurred cost. The CPI is equal to the BCWP divided by the ACWP. A CPI of one indicates that the program is on cost, while a CPI of less than one indicates the program is over-cost. If a project's CPI was 1.2, this would mean that for every dollar invested, the return is $1.20. The larger the CPI, the greater the cost efficiency. Obviously, a CPI

greater than one is desirable; however, an overly large CPI needs to be viewed in context with other factors to ensure that efficiency is not achieved at the expense of quality or technical performance.

The CPI index has proven to be stable after a contract is more than 50 percent complete [Ref. 28]. This means that the CPI index will not vary by more than +/- 10 percent in the second half of project execution. For example, if a contractor has a CPI index of .75 at the midpoint of contract execution, the best his CPI index could be is .825 at contract completion. Thus, a CPI index of less than .91 when a project is 50 percent complete would indicate a likely contract overrun. This factor allows the PM to predict contract cost overruns with confidence.

The "To Complete Performance Index (TCPI)" is used to determine the efficiency required to achieve the Budget at Completion (BAC). It takes the cost efficiency experienced to date (CPI) and determines, based on funds and work remaining, the level of performance efficiency required for the remainder of the contract to stay within the BAC. The calculation is as follows:

TCPI= BAC - BCWP CUM / BAC - ACWP CUM

This index can also be calculated using the contractor provided Latest Revised Estimate (LRE). This calculation

would show the efficiency required for the remainder of the contract to achieve the LRE. This calculation is as follows:

TCPI= BAC - BCWP CUM / LRE - ACWP CUM

Both calculations provide the PM with an objective evaluation of required contractor efficiency.

A Schedule Performance Index (SPI) is calculated from C/SSR information to provide the project manager an indication of project schedule efficiency. The SPI is equal to the BCWP divided by the BCWS. An SPI of one indicates that the work is on schedule. A schedule performance index of less than one may indicate problems in schedule and should be investigated. The project manager should know why schedule slippage occurred, what actions the contractor is taking to correct schedule problems, and have a feel for the impact, if any, that schedule problems will have on meeting a major milestone.

The project manager needs to be cautioned, however, of the potential distortions of schedule variances and SPI indices. "By itself, the C/SSR schedule variance reveals no "critical path" information, and may be misleading because unfavorable accomplishment in some areas can be offset by favorable accomplishment in others [Ref. 16: p. 179]."[1] Also, since a C/SSR schedule represents the "planned" period for the defined work tasks, this period may or may not precisely coincide with the program's overall schedule plan required to meet the

[1]A critical path is a sequential activity path which represents the longest duration of a contract. Any slippage of the tasks in the critical path will increase contract duration.

contractual obligation [Ref. 16: p. 181]. This occurs due to schedule slack associated with non-critical path work package elements that can be adjusted by the contractor, without impact on the overall project completion date.

A reoccuring schedule variance, however, can be a valuable and reliable indicator of long-term project trend. Negative schedule variances do show that work did not get accomplished. At some point unfinished work elements with slack become critical items that can affect overall project completion. By understanding the meaning and interpretation of schedule variances and the SPI index, a project manager will have a good grasp of contractor work progress.

E. OTHER ANALYTICAL TECHNIQUES AND PERFORMANCE INDICATORS

Another method used to analyze contractor performance is to review the percentage of management reserve used by the contractor. Although management reserve provides funds under management control for the unforeseen and unbudgeted circumstances, excessive use of reserve funds early in the project schedule could indicate management problems. Often, commitment of the management reserve can be correlated with cost and schedule variances. Since there is no specific guidance quantifying excessive management reserve commitment, the project manager should require further contractor explanation if he feels uncomfortable with the level or explanation of management reserve commitment.

Mr. Gary E. Christle, Deputy Director for Cost Management in the Office of the Under Secretary of Defense (Acquisition), Acquisition Policy & Program Integration, has determined that, given a contract that is more than 15 percent complete, overrun at completion will not be less than the overrun to date. Also, the percent overrun at completion will be greater than the percent of overrun to date. Essentially, the contractor cannot recover from a cost overrun status after 15 percent of contract execution. Mr. Christle explains that if you underestimated near term planning, there is no hope that you will do better on far term planning. He bases his findings on analysis of hundreds of DoD contracts. Mr. Christle's precept has been verified by DSMC. This factor provides the PM with another early indicator of a project overrun. [Ref. 16:pp. 271-272] Another indicator of potential cost and schedule problems is "perfect" C/SSR information. Perfect data means that there are virtually no cost or schedule variances with any of the reported CWBS elements. The budgeted cost for all work and the budgeted schedule for all work is equal to the actual cost of all work. Since this situation is highly unlikely, perfect C/SSR information would call into question the validity of contractor data, or suggest front-loading or rubber baselining. The project manager experiencing this situation should insist on a DCMAO review of the contractor's internal cost and schedule management system

to verify report validity, or a review of contracting accounting records by the Defense Contract Audit Agency.

F. THE ESTIMATE AT COMPLETION

The Estimate at Completion (EAC) quantifies the forecasted costs to complete the project. The contractor's Latest Revised Estimate (LRE) from column eight of the C/SSR serves as his current Estimate at Completion. The EAC or LRE consists of the total dollar value of work to date, plus the estimate of the cost of the work remaining. Due to the inherent optimistic tendency of the contractor's LRE, the project office's cost and schedule report analyst should calculate an Estimate at Completion for the contract.

There are various methods that can be used to develop an Estimate at Completion. While it is not necessary for the project manager to become an expert on all the various EAC calculation variations, it is important for him to understand the basis for EAC computations. Sometimes it is helpful for the project manager to ask his analyst to submit to him several EAC calculations, using different techniques, or using different assumptions. The PM could also request that the DCMAO Program and the Technical Support analyst assigned to support the project, provide him with an EAC using a different approach than his project analyst. This will give the PM a range of pessimistic to optimistic EACs. The PM can then

select the EAC he feels is most accurate based on his knowledge of the contractor.

The most basic formula for calculating an EAC is to add the actual cost of work performed to date (ACWPcum) to the budgeted value of the work remaining to be accomplished on the contract. The budgeted value of work remaining to be accomplished is equal to the budget at completion (BAC) minus the cumulative budgeted cost of work performed (BCWPcum). This formula is:

$$EAC = (ACWPcum) + (BAC - BCWPcum)$$

This formula considers all cost overruns to date, but treats all overruns as non-recurrent. The work remaining value assumes that the contractor will work at 100 percent efficiency in the future and any overruns will not reoccur.

Since this is seldom the case, the EAC is most often calculated by adding the cumulative actual cost of work performed to the budgeted value of work remaining on the contract times an estimated efficiency factor (EF) expected of the contractor. This formula is:

$$EAC = (ACWPcum) + (EF)(BAC - BCWPcum)$$

There are several common methods to calculate the contractor's efficiency factor. The most common and easiest

method is to use the contractor's cumulative CPI [Ref 11]. Here, the EAC calculation would be:

EAC = BAC / Cum CPI

This method assumes that the contractor will do all of the work remaining on the contract at the cost rate depicted by the CPI [Ref 14: p. 7]. Another variation on using the Cum CPI is to use a moving average of recent CPIs from over the last three to 12 months. This method involves increased effort as the C/SSR reflects cumulative information. It does, however, divorce the EAC calculation from use of historical data that may not represent current performance. The use of a current month CPI as a performance factor is not recommended since it tends to be volatile and potentially distorting [Ref 26].

Finally, the performance factor can be calculated using a weighted average of the Cost Performance Index and the Schedule Performance Index. Mr. Greg Maust, an experienced project management consultant recommends the use of an 80 percent weighted CPI and a 20 percent weighed SPI. This weighted average could be modified over the course of the contract to reflect the relative importance of cost versus schedule. For example, at the inception of a contract, the most important aspects might be schedule but as the contract progresses, the emphasis may be placed on cost [Ref 27: p. 11]. The danger in using this approach is the subjectivity associated with assigning weight. Also, a weighted average

that is changed arbitrarily, or changed to suit the situation, can distort the Estimate At Completion.

G. GRAPHING ANALYSIS/TREND ANALYSIS

An excellent tool to evaluate cost and schedule trends is graphing. When graphed, cost and schedule cumulative information provide the project manager with an excellent, simple visual tool to evaluate cost and schedule trends. It also provides an effective and versatile way to summarize an enormous amount of data [Ref. 13:p. 28]. In addition, graphs provide the project manager with a visual history of his project. Finally, graphical trend analysis is used routinely, and endorsed by the current Under Secretary of Defense for Acquisition (USDA), Mr. Yockey. His keen interest in the use of cost and schedule graphs has sparked their widespread use in project management.

There are several graphs that are particularly helpful to the PM. The most common graph is the Cumulative Plan/Status Display. This graph shows by month, actual costs (ACWP), actual accomplishment (BCWP), and planned accomplishment (BCWS). Cost variance is shown as the difference between the BCWP and ACWP curves, while schedule variance is shown as the difference between the BCWP and BCWS curves. Appendix C contains a sample Cumulative Plan/Status Display graph.

The Cumulative Plan/Status Display graph is usually represented by a "S-shaped" curve, which portrays a slow

project build-up, faster project acceleration near the middle, and a slow tapered-down end [Ref. 16: p. 256]. Any cumulative program curve that does not approximate this "S" shape is highly suspect of displaying a faulty plan [Ref. 16: p. 256]. If the PM extends a line from the displayed actual cost curve, following the "S-shaped" pattern, he can project an estimated cost for the project at completion. Similarly, if the PM extends a line from the actual accomplishment curve, he can obtain an estimate of the budgeted cost at completion for the project. This graphical trend analysis technique enables the PM to project contract overruns and project completion slippage.

Other commonly used graphs for trend analysis are the Cost Variance Graph and the Schedule Variance Graph. The Cost Variance Graph shows the cost variance over time. The cost variance can be depicted as a monthly or cumulative variance. Similarly, the Schedule Variance Graph shows the schedule variance over time. It also can be depicted monthly or cumulatively. Appendix D contains sample Cumulative Cost and Schedule Variance Graphs. Both graphs represent a visual technique for PM evaluation of contractor efficiency over time.

A variation of these graphs is the plotting of the CPI or SPI indices over time. These also could be depicted as monthly or cumulative variances. Again, these graphs provide

another visual aide for the PM to evaluate contractor efficiency.

Management reserve usage is also often graphed. The Management Reserve graph often displays the cumulative management reserve usage, the cumulative cost variance and the cumulative schedule variance over time. This graph shows the PM the relationship between management reserve application, and cumulative cost and schedule variances. As mentioned previously in this chapter, early commitment of management reserve is often an early indication of cost or schedule problems. Appendix E contains a sample Management Reserve graph.

H. PERFORMANCE ANALYZER SOFTWARE USE IN C/SSR ANALYSIS

Performance Analyzer (PA) was developed by Thomas/Scifers Inc., for the Air Force Space Systems Command to streamline and automate cost and schedule reporting and analysis. It was designed to meet the needs of program managers, financial analysts, and project engineers [Ref. 29:p. i]. Over the past few years, PA has been introduced to all military services and is rapidly becoming the standard cost and schedule analysis software package used throughout DoD. Performance Analyzer is user-friendly and menu driven. It supports IBM/XT/AT compatible computers; EGA, Hercules, or VGA graphic cards; IBM or Epson compatible printers and Hewlett Packard laserjet printers; DOS 3.2 or higher; and the Hewlett-Packard plotter.

The system also requires a hard drive with a minimum of 485K RAM. Performance Analyzer can perform a wide variety of computations, including:

1. Mathematical checks for data errors
2. Percent complete by WBS element
3. Current and cumulative cost and schedule variance
4. CPIs and SPIs for current and cumulative data
5. Variance at Completion
6. To Complete Performance Index
7. EAC calculations using weighted indices and three month moving averages. [Ref. 25:pp. 33-34]

Performance Analyzer can also display, print, and plot cost and schedule management graphs for project management use. Among the graphs PA can plot are:

1. Cumulative or current cost or schedule variances in dollars
2. Cumulative or current cost or schedule variances in percent
3. SPI indices
4. CPI indices
5. Percent complete (percent dollars spent versus percent complete)
6. EACs
7. Management Reserve [Ref. 29:pp. 6-13 to 6-26]

In addition, cumulative or current cost or schedule variances and indices can be displayed for CWBS elements as well as for the total project.

Performance Analyzer also prepares several reports that are useful for the non-major program cost and schedule manager. It will also prepare the C/SSR itself including the C/SSR contractor analysis section. Among the reports PA can prepare are:

1. A Management Reserve Status report: This report displays BCWP versus the amount of Management Reserve remaining for the last six months. [Ref. 29:p. 6-32]

2. A Program Manager Summary report: This report displays the CWBS performance data for all elements for a selected month. [Ref. 29:p. 6-35]

3. Executive Summary report: This report is a one page report that displays important contractual and performance information for a given month. [Ref. 29:p 6-36]

4. Six Period report: This report displays the last six months of performance data and related forecasts-to-complete for a WBS element. [Ref. 29:p.6-30]

Performance Analyzer also has the capability to support on-line automated data transfer with a contractor or higher command. This aspect significantly reduces the time required for project analyst manual data entries. According to a senior DoD official within the USD(A) Acquisition Policy and Program Integration Office, the Government can even specify Performance Analyzer use in the Request for Proposal, and provide a copy of PA to the contractor [Ref. 13]. This reduces cost and schedule management costs for the contractor and further standardizes cost and schedule management software usage.

I. MANAGEMENT ACTIONS

There are no guaranteed "cookbook" methods available to a project manager to use as problems arise. However, there are several management actions that the PM can take short of contract termination, once problems are identified through C/SSR review and analysis. Naturally, careful PM vigilence to avoid or "catch" problems early is preferred. In all cases,

the PM should tailor his management actions based on his assessment of the project's situation.

Once the project manager has identified cost or schedule variances through review and analysis of the contractor's C/SSR, he should carefully review the contractor's C/SSR narrative comments. The project manager should be satisfied with the explanations provided by the contractor for all variances exceeding thresholds, or seek further contractor explanation. The contractor should have clearly stated in his narrative the cause of the specific problem, its impact on the immediate task and on the total program, the actions he has taken to correct the problem, and an estimated timeframe within which the problem will be corrected [Ref 25. p. 6].

The project manager should not hesitate to conduct follow-up communication with the contractor to clarify further aspects of the contractor's narrative and to discuss problem corrections. The project manager also should recognize that problems are not always the fault of the contractor. Delays in delivery of Government Furnished Equipment (GFE) and technical problems with GFE are among the most common Government induced problems.

Although there can be a variety of reasons variances occur, it is helpful for the project manager to be familiar with some common causes. The project manager needs to decide whether he feels that the variance is due to a "one-time" mistake or circumstance, or whether there is an underlying systemic

problem. The most common causes for unfavorable variances are poor management, poor initial planning or estimating, technical problems, higher cost of materials or labor than expected, material delivery problems, and sometimes, poor weather. Favorable variances can be attributed to poor management initial planning or estimating (overly conservative approach), technical breakthroughs, or lower cost of materials and labor than anticipated. Variances (both positive and negative) can also appear due to the different way contractors measure earned value for open work packages as discussed previously in Chapter III.

After the project manager has reviewed the contractor's narrative and discussed the situation with the contractor, he may want to conduct an *on-site investigation* to further his understanding of the problem(s). He can request assistance to conduct additional contractor surveillance from the DCMAO program and technical support personnel assigned to support his project. He also can request assistance from the Defense Contract Audit Agency (DCAA) to review contractor accounting records.

Once the PM has a good understanding of the cause(s) for cost and schedule variances and has discussed the situation with the contractor, he should continue to monitor contractor corrective actions. The project manager should require the contractor to brief him regularly on his corrective plan's progress and should evaluate the contractor's progress

objectively based on subsequent monthly C/SSR analysis. The PM should recognize that contractors tend to be "optimistic" about their project to avoid potential project cancellation.

The PM should not hesitate to keep his management informed of cost and schedule problems and corrective actions taken. Sometimes, it is extremely effective for the PM to request that his manager express performance concerns directly to the contractor's PM, Chief Executive Officer (CEO) or other senior official. One PM was particularly effective in using this technique. Using C/SSR trend analysis, the PM identified contractor cost and schedule problems within the first six months of a four year contact. After continued poor performance and no problem improvement, the PM asked his Program Executive Officer (PEO) to visit the contractor's facility and express his dissatisfaction with the contractor's project manager and CEO. This action expressed senior officer concern and served as a catalyst for contractor corrective action.

The project's Administrative Contracting Officer (ACO) also assesses contractor performance in his review of a contractor's progress payment requests. The ACO will use C/SSR data and trend analysis to decide whether the contractor should receive progress payments as requested, or whether progress payments should either be partially or totally withheld due to a lack of work progress. Although the PM is not directly involved in progress payment review, he can influence the ACO's decision by expressing his assessment of the con-

tractor's progress to the ACO through the PM's PCO. The PM needs to, therefore, understand the potential advantages and disadvantages of partially or totally withholding progress payments. The PM's PCO should advise the PM on this important issue.

Withholding progress payments has the advantage of expressing serious concern regarding the contractor's performance. It heightens contractor management attention by endangering his cash flow and potential profits. Sometimes even the mere threat of withholding progress payments is enough to motivate the contractor to take decisive management action.

Withholding progress payments, however, can seriously affect the contractor's cash flow. This can be a disadvantage, especially for a highly leveraged contractor. It takes cash to correct problems. Thus, without a sufficient cash flow, a contractor could be strapped for funds to continue project work as planned. This may exascerbate the poor performance problem and could lead to more serious actions such as contract termination.

J. REPROGRAMMING: THE OVER TARGET BASELINE

If cost and schedule problems persist on a contract, and the contractor decides that the amount of budget remaining is decidedly insufficient to accommodate the remaining work, the contractor may propose to the PM implementation of an over target baseline (OTB). An over target baseline, or "repro-

gramming," is when a contractor requests approval to manage to a goal above the contract target cost. It results in the contractor's total allocated budget (TAB) exceeding his contract budget base (CBB) [Ref. 22:p. 15]. It also results in a major restructuring of contractor efforts. It is a formal declaration of an overrun by the contractor.

An over target baseline may only be implemented a maximum of once a year and only with Government PM approval. It may not be implemented if the project has six months or less remaining. Before approving a contractor reprogramming request, the PM should be confident of the following:

1. The contractor has an adequate cost and schedule control system.
2. The contract budget remaining is clearly inadequate to perform the remaining work.
3. The remaining authorized work can be determined.
4. The remaining authorized work can be scheduled.
5. The contractor clearly understands the reason leading to the overrun.
6. The contractor has a plan of action to prevent problems from reoccurring [Ref. 31: p. 105].
7. The contractor has detailed estimates of all costs necessary to complete the contract and has clearly identified the additional budget required.
8. He can obtain additional funding for the reprogramming request.

Obviously, the PM should not regard reprogramming requests lightly. Reprogramming should not be accomplished simply to eliminate variances for work already accomplished [Ref. 15: p. 4-12]. However, once a baseline is no longer representative

of project work, performance reports are often ignored and program managers may resort to other informal means of tracking the contract [Ref. 30:p. 5]. Also, by continuing project execution under an unrealistic baseline, the PM loses visibility of new problems [Ref 11]. Reprogramming allows the PM to focus on new problems by resetting cost and schedule variances to zero. The PM still has visibility of old problems through the contractor's submission of a latest revised estimate (LRE) with his C/SSR. A reprogrammed project LRE would indicate an estimated overrun for remaining work [Ref. 11].

The PM also can retain visibility on total cost variances by calculating the ratio between the total allocated budget before reprogramming and the total allocated budget after reprogramming. He could then multiply the BCWP and BCWS elements shown in columns two and three of the C/SSR, by the ratio to obtain the project's total cost variance. Some project managers choose to graph the cost variance both with and without this ratio to focus on the contractor's performance following reprogramming, while retaining visibility of total project cost variances. [Ref. 32]

Another approach the PM can take to ensure he retains visibility of the total contract cost variance is to specify in the contract solicitation that the contractor provide reprogramming adjustment reporting with his monthly C/SSR [Ref. 15:p. 4-11]. This is a standard reporting requirement

in the Cost Performance Report used in cost and schedule reporting for major programs. This would require the contractor to indicate the budget adjustment applicable to each reported WBS element. It also would require him to show the total cost variance for each reported WBS element. However, before requiring the contractor to submit reprogramming adjustment reporting, the PM should weigh the additional financial costs associated with the additional reporting, against his management need for total cost variance visibility.

It is important for the PM to approve an OTB in a timely manner. Generally, OTB approval should be granted within 60 days after the contractor's request submission [Ref. 10:p. 3.4-11]. Since the contractor cannot move to his new plan without PM approval, approval delays may make the contractor's new proposed plan obsolete before it can be implemented [Ref. 30:p. 4].

K. CHAPTER SUMMARY

This chapter has provided the reader with an understanding of the basic tools needed to conduct C/SSR analysis. It has provided an understanding of trend analysis by familiarizing the reader with some commonly used graphical techniques. The chapter also exposed the reader to the capabilities of Performance Analyzer software and described its use in project management. Finally, Chapter IV has discussed several

management actions the PM can take once he has identified cost and schedule problems.

Chapter V will analyze how the Navy's A-12 Avenger program termination has affected the C/SSR environment. It will examine Army, Navy, Air Force, and OSD cost and schedule management initiatives taken since the A-12 termination. It will analyze some of these initiatives and identify lessons learned. Finally, it will propose recommendations for future cost and schedule management initiatives.

V. THE A-12'S AFFECT ON THE C/SSR ENVIRONMENT. INITIATIVES TAKEN, LESSONS LEARNED, AND RECOMMENDATIONS FOR FUTURE INITIATIVES

A. CHAPTER INTRODUCTION

On 8 January 1991, the Secretary of Defense, Mr. Dick Cheney, terminated the Navy's A-12 Avenger program. At that time, the A-12 was one billion dollars over its target cost and, as expressed by Mr. Cheney, "No one can tell me exactly how much more it will cost to keep this program going" [Ref. 33:p. 1]. Among other issues, both the contractors and the Navy were found to have made inadequate use of cost and schedule data for project management. As concluded by the Beach Administrative Inquiry, "existing control mechanisms, properly operated, would have been sufficient to identify the nature and extent of the problems in this contract..." [Ref. 34, p. 33]. As a direct result of the A-12's termination, both the A-12 Program Manager and PEO for Tactical Aircraft Programs, were relieved of their duties.

The A-12's "demise" sent shock waves throughout the Defense acquisition community. Through this highly visible contract termination, Mr. Cheney sent a clear message that cost and schedule management is so important that if a PM fails to use prudent management practices, his program can and will be canceled [Ref. 35:p. 2]. This has led to a heightened OSD interest in cost and schedule management and a number of

actions throughout DoD to strengthen cost and schedule control practices.

Although there are no specific actions that have been directed solely at non-major projects, there have been many reforms directed at cost and schedule practices initiated by all three military services and OSD that have affected non-major acquisitions. These actions suggest a renewed interest in improving cost and schedule management throughout DoD. This chapter will describe these reforms, analyze their impact on the C/SCR environment, and discuss any applicable lessons learned from A-12 termination.

B. USD(A)/OSD INITIATIVES

The selection of The Honorable Donald J. Yockey as the Under Secretary of Defense (Acquisition), shortly after the resignation of Mr. John Betti, was the most visible and powerful action taken by the Secretary of Defense to emphasize cost and schedule management. It is speculated that Mr. Betti resigned due to the problems leading to the A-12's termination. Mr. Yockey, the Deputy USD(A) under Mr. Betti, is a strong advocate of performance management. His personal interest in promoting the use of earned value as a productive management approach for defense contracts has resulted in a renewed interest in its use throughout the DoD acquisition community, including non-major project management [Ref. p: 15].

This renewed interest was evident at the 1991 National C/SCSC Workshop. This workshop attracted a record attendance of 641 participants from both DoD and defense contractors. Mr. Yockey's keynote address at the workshop was a highly visible example of the value he places on cost and schedule control management.

Mr. Yockey has emphasized the need for increased performance management training throughout DoD. One initiative was the establishment of a new billet within the Office of Acquisition Policy, Program Integration and Cost Management. An Army Lieutenant Colonel currently fills this position. Mr. Yockey has charged this officer with the responsibility to improve cost and schedule management education, starting with a review of the earned value content of all DoD acquisition training and education [Ref 1:p. 18].

This review of DoD acquisition training and education has revealed significant shortfalls in earned value education. One of the findings was that often a PM's first formal training in cost and schedule management was during attendance at the DSMC Program Manager's Course [ref. 36]. The review also revealed that from 1987 to 1989, the Air Force Institute of Technology's School of Systems and Logistics was only able to meet 26-29 percent of enrollment requests for their cost and schedule management courses, due to funding constraints [Ref. 36]. Further, although requests for the Contractor Performance Measurement Course at DSMC have doubled, annual

course offerings were reduced from ten in 1991 to seven in 1992 due to budget constraints [Ref. 36].

This training review effort has contributed to the release of three key Department of Defense publications. First, on 25 October 1991, Department of Defense Directive 5000.52, *Defense Acquisition Education, Training, and Career Development Program*, was published. This publication updates policy and responsibilities for a career development program for acquisition personnel. It also specifies the establishment of a functional board to review DoD business, cost estimating, and financial management education and training.

Second, on 15 November 1991, the Under Secretary of Defense (Acquisition) published the *Career Development Program for Acquisition Personnel Manual*. This manual provides uniform procedures for a DoD Career Development Program for Acquisition Personnel, consistent with the general policies and authorities stated in DoD Directive 1430.2, *Civilian Career Management*, and appropriate component civilian and military personnel regulations [Ref. 38:p. i]. It also implements the education and training programs authorized by Chapter 87 of Title 10, United States Code [Ref. 38:p. i]. This document clearly specifies required training by acquisition discipline and by career level, including mandatory and desired performance management training, experience, and education.

Third, OSD staff efforts have contributed to the publication of Department of Defense Instruction 5000.58, *Defense*

Acquisition Workforce on 14 January 1992. This document establishes policy, assigns responsibility, and prescribes procedures and criteria for designating acquisition positions and critical acquisition positions, for management of the acquisition workforce, and for establishing and managing the Acquisition Corps [Ref. 39p: 1].

Currently, there is an effort at the Department of Defense to "fence" funding for acquisition education including performance management courses. This action would alleviate training fund cuts at both AFIT and DSMC. Until this occurs, shortfalls are likely to remain in cost and schedule management education.

Renewed DoD interest in performance management training has also sparked a substantial increase in correspondence course and training seminar requests. Requests for the Contractor Performance Measurement correspondence course at DSMC have doubled during the past year [Ref. 11]. Also, because of significant demand, Policy Analysts from the Office of Acquisition Policy, Program Integration, and Cost Management tripled the number of cost and schedule management training seminars they teach to project office personnel [Ref. 1:p. 18].

Finally, Mr. Yockey's interest in cost and schedule analysis has resulted in the formation of a Tri-Service and Defense Logistics Agency Panel for Performance Analyzer (PA) software. This panel centralizes funding for PA version

updates, serves as a focal point for PA problems and issues, and centralizes PA distribution. Currently, this panel is working on PA upgrades that will incorporate additional standardized management briefing charts.

C. NAVY INITIATIVES

Of the three military services, it appears that Navy has taken the most action to strengthen cost and schedule control. On 14 March 1991, pursuant to the A-12 Administrative Inquiry recommendations, the Assistant Secretary of the Navy, Research, Development, and Acquisition (ASN(RD&A)), chartered a Cost Performance Analysis Working Group (CPAWG). This working group was tasked to identify and report recommended actions necessary to revitalize Navy cost performance analysis. The group reviewed cost performance analysis policies, processes and capabilities currently in place and conducted extensive interviews. [Ref. 40:p. 4].

The Cost Performance Analysis Working Group identified twenty two recommendations to strengthen cost and schedule management throughout the Navy. Their findings and recommendations were grouped into four major areas; leadership commitment, policy and guidance, training, and resources.

1. Leadership Commitment

Among the recommendations regarding leadership commitment affecting C/SSR management is the development of an early warning system to support PMs and all Navy acquisition

executives. This warning system would use red, yellow, or green assessment criteria based upon cost and schedule performance indices (CPI and SPI) and variance-at-completion (VAC) percent. A yellow condition would require a report by the PM to his next management level. Similarly, a red condition would require a report by the PM to his next management level and to the program Milestone Decision Authority. A green condition would not require any special reporting to higher management. [Ref. 40:pp. 17-20]

Leadership commitment recommendations also included a recommendation for the ASN(RD&A) to publish an expectations policy memorandum to all PEOs and PMs, emphasizing his requirement for senior managers to know and use cost and schedule analysis in project management. The working group also recommended that the ASN(RD&A) require C/SSR or CPR summary data presentation at regular program reviews and reinforce the need for regular on-site contractor cost and schedule surveillance and independent analysis by DCMAO or DPRO personnel. In addition, the group recommended that the Navy establish a multi-functional working group to explore the development of an integrated, real-time program management information system. [Ref. 40:pp. 17-20]

2. Policy and Guidance

Among the policy recommendations specified was the establishment of uniform cost performance management and analysis requirements at all System Commands (SYSCOMS) for all

Acquisition Category (ACAT) programs, the requirement for project offices to coordinate WBS development with their central SYSCOM, and the establishment of uniform cost performance analysis summary data at each echelon of acquisition oversight. Other policy recommendations included a requirement for the use of electronic data transfer of cost performance management data for all new contracts and the requirement for PMs to require contractor briefings on monthly cost and schedule data at periodic program reviews. [Ref 40:pp. 21-26]

3. Training

Training recommendations included the need for a review and survey of cost and schedule management training requirements and school request shortfalls, and the requirement for all program business/financial managers to attend the AFIT two week cost and schedule management course. Also recommended was the review and establishment of WBS training requirements. Finally, recommendations were made that acquisition commands require, implement, and track employee cost and schedule management training. [Ref. 40:pp. 27-29]

4. Resources

Resource recommendations included the establishment of centralized cost performance measurement organizations within each Systems Command and in matrix organizations supporting project offices, and that funds be identified and provided to support these focal point organizations. Finally, the

working group advocated the establishment of Performance Analyzer as the Navy standard cost and schedule management information system. [Ref. 40:pp. 30-33]

These recommendations are currently awaiting final review and approval by the Assistant Secretary of the Navy, RD&A, the Honorable Gerald A. Cann. However, revitalization efforts have been initiated within several of the Navy SYSCOMS. For example, the Naval Air Systems Command (NAVAIR) has established and conducted a command cost performance measurement and analysis training program for PEOs, PMs, program office staff members, and other key senior management within NAVAIR [Ref. 40:p. 4]. Although the course was limited to several hours of training, it provided training in fundamental cost and schedule management concepts.

The Naval Sea Systems Command (NAVSEA) has also conducted a five day performance management training course targeted at its 21 cost estimating personnel [Ref. 40:p. 5]. In addition, the Assistant Secretary of the Navy, (RD&A) C/SCSC focal point commmissioned a tailored, executive version of the one week DSMC "Contract Performance Measurement Course." Key senior Navy acquisition personnel and PEO staff members attended this seminar. [Ref. 40:p. 5].

D. ARMY INITIATIVES

The Army has taken several initiatives as a result of increased performance management emphasis following the A-12

termination. The Honorable Stephen K. Conver, Assistant Secretary of the Army (RD&A), directed a study of current Army cost and schedule management practices. The study group solicited input from senior Army leadership, PEOs, and senior staff members. The group generated 63 pages of input that was categorized into ten issue areas. The Army identified an expert for each issue area. These experts provided comments based on this input. The study concluded that no additional controls were required, that the Army should continue the thrust of their current performance management program, and that Army PEOs/PMs were the first line of defense against problems similar to the A-12. The study did advocate the promotion of proper sensitivity and vigilance in cost and schedule management and recommended the implementation of four actions to accomplish this goal. [Ref. 41: pp. 1-5].

The first recommendation was to develop an independent and effective program assessment capability at the Army Acquisition Executive (AAE) level. The second recommendation was to revise PEO/PM charters to clarify and strengthen their duties in cost and schedule management. The third recommendation was to require special management of joint ventures and other teaming arrangements to provide for the "fixing" of corporate responsibility for problems. The final recommendation was to establish local "lessons learned" reading files. These files would provide common sense advice to PMs and their staffs. It is the researcher's opinion that this measure is not very

substantive and will have little impact on improving Army cost and schedule management.

Mr. Conver approved all recommendations except the independent program assessment capability at the AAE level. It was felt that this independent team would provide an unwarranted level of "checkers" at the AAE level. Also, the Assistant Secretary of the Army, Research, Development, and Acquisition (SARDA) staff could not afford to commit assigned personnel assets to compose this team, and funding constraints prevented the establishment of new billets for this function. [Ref 42]. Mr. Conver summarized the adopted initiatives in a memorandum dated 7 October 1991, "Army Acquisition Executive (AAE) Policy Memorandum #91-7, "A-12 Lessons Learned [Ref. 43:p. 1]."

Mr. Conver also expressed his concern about cost and schedule management in both the September-October 1991 and November-December 1991 issues of the *Army Research, Development & Acquisition Bulletin*. Both articles reflect his emphasis on major program management. The articles have implied messages for smaller, C/SSR managed projects. As he stated in the September-October issue, "In the future, we can no longer afford to overrun program schedules or exceed budgets" [Ref. 46:p. 45]. He asserts that cost and schedule management techniques can help avoid such problems if managers understand and pay attention to the performance management information [Ref. 46:p. 45].

In the November-December issue, Mr. Conver advocated contract management as a team effort involving the ACO, PCO, as well as the PM and PEO [Ref. 47:p. 52]. He also emphasized that the contractor's performance must be carefully monitored to provide early problem detection [Ref. 47:p. 52].

E. AIR FORCE INITIATIVES

The Air Force has also increased its emphasis on cost and schedule management. In particular, the Air Force Systems Command (AFSC) has taken several initiatives to promote performance management. Lieutenant General Thomas R. Ferguson, Commander, Air Force Systems Command, demonstrated his concern about cost and schedule management in a memorandum dated 17 December 1990, "Inspector General Report on A-12 Program." This memorandum emphasized the need for the Air Force to learn from the A-12's errors to prevent their reoccurrence [Ref. 44:p. 1]. The Air Force Systems Command has also reorganized its cost management division to include the establishment of an analysis branch and implemented a quarterly cost and schedule management training program.

The Air Force is also experimenting with acquisition innovations in its F-22, Advanced Tactical Fighter (ATF) Program. The contractors were freed from binding, rigid specifications. Also, the ATF project office assigned military project teams to work with the contractors. Each project team has responsibility for all aspects of a particu-

lar component from drawing board to manufacturing. The teams work closely with the contractor to ensure program requirements are met on schedule and at cost. The ATF project office also instituted a cost and schedule "flash report" that provides the PM timely insight into potential problem areas within 10 working days after accounting close. This "flash" report is an unaudited CPR (format one).

It is unsure exactly how these ATF innovations will affect non-major project offices. At this stage of development it is obvious that the increased communication and cooperation between Government and industry evident in this project could provide a role model for other programs including non-major acquisitions. Also, since the "flash" report provides the PM timely notification of project cost and schedule information, its use should be explored for C/SSR managed projects. Perhaps lessons learned on ATF specification reductions and project teams can result in future initiatives benefiting all projects.

F. LESSONS LEARNED FOR NON-MAJOR PROGRAMS/ COMMENTS/ RECOMMENDATIONS FOR FUTURE INITIATIVES

Perhaps the greatest shortfall evident from the A-12 "fallout" was the lack of a coordinated training effort throughout DoD. Although AFIT and DSMC each provided cost and schedule management education, there was no central attempt to quantify training needs or shortfalls, identify personnel

requiring training, or "mission" essential tasks for each school to teach. It was obvious through the researcher's visit to each school that both DSMC and AFIT have a cadre of professional, dedicated personnel who are attempting to provide the best training, given available resources. However, without a comprehensive review of all cost and schedule training and an identification of all personnel who require training, it is difficult to quantify performance management training requirements and justify additional funding. A coordinated OSD-led focus is required to orchestrate this effort.

Fortunately, OSD has assumed a definitive leadership role in performance management training. The creation of the billet within the USD(A) Cost Management Section to focus on training requirements has contributed greatly to coordinating training efforts. These efforts, previously described in this chapter, provide a foundation for the future of performance management education. However, without "fenced" funding for identified Acquisition Enhancement Program and other acquisition courses that teach cost and schedule management as part of their curriculum, the benefits of OSD's efforts will not be realized.

It is obvious that voids of cost and schedule management knowledge remain throughout DoD. The researcher confirmed this fact through interviews with various personnel throughout the acquisition community. This problem was particularly

evident on smaller contracts. Project staffs on small R&D contracts are often limited. The project manager of many of these projects, particularly in the lab environments, is often a senior engineer or scientist. These engineers and scientists are often not formally trained or educated in the business or financial aspects of contracts. Thus, they focus their efforts on technical aspects, sometimes at the expense of sound cost and schedule management. It is, therefore, important for the military services to ensure that these personnel also be identified to receive cost and schedule management education and training.

The Navy, through its Revitalization Plan, clearly recognizes the need for increased performance management training. Of the three military services, it is attempting to take the most definitive training actions. It is the researcher's opinion, however that the Navy's requirement for acquisition commands to require, implement, and track a one week employee cost performance management training course is a burdensome and complex requirement. Although educational opportunities should always be encouraged, the Navy's performance management training requirements should be assimilated into a central DoD focus to maintain quality teaching standards and course standardization. If the Navy does implement this recommendation, its cost and management course should be assimilated as part of the Defense Acquisition University structure.

Declining military budgets will demand training innovation. According to Rear Admiral Vincent, Commandant, Defense Systems Management College, he is already exploring innovative training approaches using video and satellite technology [Ref. 45]. Another approach might be a requirement for students to complete a basic cost and schedule control familiarization correspondence course as a prerequisite to attendance at a formal DoD performance management school. This would allow resident class time to focus on more complex or detailed aspects of cost and schedule management, while ensuring a basic foundation of knowledge for all students.

Another training option for DoD to explore is the implementation of periodic on-site seminars at major service acquisition commands. These seminars could be taught by a cadre of experience performance management instructors from AFIT or DSMC, or could be contracted out to civilian cost and management consultants. There are a number of highly experienced management consultants qualified to conduct this training, many with years of former DoD experience. These seminars should be funded and scheduled by DoD. If possible, these seminars should also be open to contractor PMs and their staffs [Ref. 32]. This action would further communication between Government and contractor program offices, while promoting performance management education.

A final innovative teaching idea is the development and implementation of a DoD *Best Practices* manual for cost and

schedule management [Ref. 13]. This manual could be structured similar to the existing Department of the Navy *Best Practices* manual used for reliability, maintainability, and quality assurance. The manual should identify "traps" to avoid in cost and schedule management, "alarms," or warning signs of impending traps, and consequences which can result from traps. It should also provide recommended "escapes" to traps, and the benefits associated with these escapes.

The *Best Practices* manual should be organized into three sections. The first section should include "traps" applicable to all systems. The second set should include "traps" applicable to major system acquisitions managed by the CPR. The final section should specify "traps" unique to non-major system acquisitions managed by the C/SSR.

Enormous benefits could be gained from this manual. It would provide a valuable tool for all PMs, their staffs, contracting officers, DCMAO/DPRO personnel, and other acquisition personnel on cost and schedule management issues. It would be a particularly useful reference for inexperienced, new personnel. Finally, this manual could incorporate cost and schedule management "lessons learned" from throughout DoD, providing an opportunity to prevent future, similar problems.

Another "lesson learned" from the A-12 termination is that project managers emphasize aspects in project management that they feel their boss is most concerned with, and those they understand best. Cost and schedule management is often not

among these aspects. Therefore, if cost and schedule analysis is not used routinely throughout the project management chain of command, there is no guarantee that it will be used among lower level project managers. Mr. Yockey has made it clear throughout DoD that he is an advocate of earned value and its use as a management tool. This sentiment has filtered down through the chain of command in all three services, as evidenced by memoranda advocating its use released by senior executives in all three military services.

However, there is still a tendency for C/SSR-managed projects to fall into the shadow behind major C/SCSC-managed programs. As budgets decline, C/SSR-managed contracts will likely increase in number. This situation will require increased senior management attention and understanding of C/SSR-managed projects.

Finally, the A-12's termination forced all three military services and OSD to carefully review cost and schedule management practices. These self-examinations have focused primarily on major program management, but have positive implications for non-major acquisitions. These reviews have led to a heightened awareness of the importance of performance management, various initiatives to improve cost and schedule management, and a search for innovation for future project management. The Air Force best exemplifies this innovation in its ATF Program, previously discussed.

All these actions suggest hope for continued improvement in cost and schedule management throughout DoD. However, in order for performance management to be effective, senior managers must be prepared to terminate projects for cost and schedule problems if justified. Too often, projects with performance management problems are continued with futile hopes of performance improvement. Some projects are continued in spite of cost and schedule problems, with the hope of obtaining needed technology. There is no guarantee that continuation of these contracts will produce desired results. Senior managers need to use cost and schedule trend analysis to make these hard decisions about project continuation and future funding. Trend analysis provides valuable insight to project future project status, allowing senior managers to make informed decisions on these issues.

G. CHAPTER SUMMARY

This chapter examined how the Navy's A-12 Avenger Program termination has affected the C/SSR environment. Particularly, the chapter examined performance management initiatives taken by all three military services and OSD since the A-12 termination. This chapter analyzed some of these initiatives and discussed lessons learned. Finally, this chapter proposed several recommendations for future cost and schedule management initiatives.

Chapter VI will analyze the December 1991 proposed *C/SSR Joint Guide*. This analysis will examine how the guide should be changed to retain adequate uniformity, while allowing project managers flexibility to tailor requirements based on contract size. This chapter will also analyze contractor plant visits and their role in the C/SSR process. Finally, Chapter VI will provide recommendations to improve cost and schedule management on non-major DoD acquisitions.

VI. ANALYSIS OF THE PROPOSED C/SSR JOINT GUIDE REVISION AND RECOMMENDATIONS FOR IMPROVEMENT OF COST AND SCHEDULE MANAGEMENT

A. CHAPTER INTRODUCTION

This chapter will analyze the December 1991 proposed *C/SSR Joint Guide*. This analysis will focus on how the guide should be changed to retain adequate uniformity, while allowing the non-major system project manager the flexibility to tailor requirements based on contract size. Chapter VI also will analyze contractor plant visits and their role in the C/SSR process. Finally, this chapter will include recommendations to improve future C/SSR management.

B. BACKGROUND/HISTORY OF THE *C/SSR JOINT GUIDE* REVISION

As a result of a strong recommendation from representatives at the 1989 National Security and Industrial Association's (NSIA) National Cost and Schedule Management Workshop, a joint industry/DoD process action team (PAT) was formed to review and update the *C/SSR Joint Guide [Ref.* 48]. Industry cost and schedule management representatives felt that the 1978 guide no longer provided adequate guidance to ensure uniform cost and schedule management throughout DoD. Since 1978, it seemed that each military service and/or command had developed varied interpretations of the guide, leading to inconsistencies in such areas as contractor plant visits, C/SSR implementation,

and C/SSR surveillance. One contractor, in particular, complained that each of his twenty Government contracts had a different set of C/SSR requirements [Ref. 23]. These problems contributed to confusion, frustration, and friction between the Government and contractors.

The PAT team's C/SSR Joint Guide draft was not completed until February 1991. Changes in PAT leadership contributed to the lengthy time it took to complete the draft. The process action team sent its completed draft to the NSIA management systems subcommittee and to the DoD Performance Measurement Joint Executive Group (PMJEG) for comment and review [Ref. 48]. The PMJEG rejected this draft in September 1991.

The PMJEG rejected the process action team's draft for several reasons. First, since publication of the draft, the Defense Acquisition Regulation (DAR) Council had drafted a new DFARS clause regarding the C/SSR. The *Federal Register* published this draft clause on 31 July 1991. The clause had a proposed implementation date of 31 December 1991. The clause (DFARS 252.242-7005) specified minimum requirements for contractor management procedures and outlined specific contractor responsibilities in the execution of C/SSR management. Details of this clause were discussed in Chapter III, "C/SSR Implementation." Since the process action team's draft did not reference the new DFARS clause, or reflect its intent, the PMJEG rejected the PAT draft [Ref. 13].

The PMJEG rejected the PAT draft for several other reasons as well. DoDI 5000.2, *Defense Acquisition Management Policies and Procedures*, published on 23 February 1991, raised CPR application thresholds to $60 million dollars for R&D contracts and $250 million dollars for production contracts (in 1990 dollars). This meant that C/SSR now had a wider application within DoD. Members of the PMJEG felt that this threshold application change merited a reexamination of C/SSR guidance. Some members advocated exploring a "tiering" approach to the C/SSR, with the application of more stringent reporting requirements for larger C/SSR programs. [Ref. 13] This "tiering" concept will be discussed and analyzed later in this chapter.

Second, the PAT *C/SSR Joint Guide* draft contained a 65 item comprehensive contractor plant visit checklist. This checklist was included to provide Government personnel specific guidance in the conduct of contractor plant visits. Members felt that this "yes" or "no" checklist approach brought C/SSR closer to resembling a CPR management system requirement [Ref. 13]. The original intent of the C/SSR was not to impose the 35 specific management system criteria of the CPR, in order to maintain a flexible, and less extensive reporting system. DoDI 5000.2 reaffirmed the C/SSR as a data item requirement, as opposed to a management system requirement [Ref. 13]. Contractors also strongly opposed the "yes" or "no" checklist

approach because of the implied "pass/fail" management system requirement [Ref. 32].

At the October 1991 NSIA National C/SCSC Workshop, the issue of a new *C/SSR Joint Guide* again emerged as an area of concern for workshop participants. Participants were frustrated with the slow progress toward an updated *C/SSR Joint Guide*. The Air Force PMJEG representative volunteered to assume responsibility for drafting a new guide. The Air Force PMJEG published this draft on 11 December 1991 and distributed it to industry and DoD representatives for review. Presently, the Air Force is awaiting final industry and DoD comments for evaluation and incorporation into the guide.

It has been almost three years since the *C/SSR Joint Guide* revision effort was initiated. As a result, the DoD is still operating under an outdated 1978 guide. For example, the 1978 guide defines "non-major" contracts as "those to which the DoD Cost/Schedule Control Systems Criteria are not required; usually development contracts under $25 million or production contracts under $100 million [Ref. 2:p. 1-1]." Both the earlier DoDD 5000.1 published in 1987 and the most recent DoDI 5000.2 make this definition obsolete. Unfortunately, this outdated guidance contributes to confusion in C/SSR implementation and execution.

C. THE C/SSR "TIERING" CONCEPT

There is still debate as to how the C/SSR should be changed to retain adequate uniformity in reporting requirements, while allowing the project manager flexibility to tailor requirements based on contract size and complexity. Some advocate the establishment of a "tiering" concept for non-major projects. One version of this concept would involve the establishment of two tiers. The lower tier would apply to small, technically low-challenge projects. These projects would implement the C/SSR without change. The plant visit would consist of a "walk-through, talk-through" by the contractor on the essential features in the cost and schedule management system required to satisfy the contract. [Ref. 50:p. 2]

The upper tier would apply to larger, more complex, technical non-major projects, which is admittedly vague. These projects would implement a "reasonably rigorous" management control system, or a scaled-down version of the cost/schedule control systems criteria (C/SCSC). The plant visits would be more formal, similar to a Subsequent Application Review used on major CPR managed contracts.[2]

The upper tier C/SSR managed programs would also maintain a management systems description, similar to major contracts.

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[2]A Subsequent Application Review (SAR) is a visit by Government personnel to a contractor's facility to determine whether the contractor has properly applied the management control system which had been previously accepted as meeting the requirements of C/SCSC, to a new contract [Ref. 16:p. 520].

[Ref. 50:p. 2] A management system's description is a formal written document of the contractor's management data development process, identifying such aspects as baseline development, periodic control cycles (methods for reviewing the plan's progress), and baseline changes [Ref. 52:p. 17]. Finally, upper tier contract cost and schedule reporting would also include submission of format three of the CPR, baseline reporting [Ref. 51:p. 16]. The baseline reporting format records the net effect of monthly changes to the baseline at the total contract level [Ref. 53:p. 4]. The "tiering approach" concept makes intuitive sense by providing a more rigorous and disciplined system to larger C/SSR managed projects, while maintaining minimum standards for smaller projects. In fact, the Australian Government is currently contemplating the implementation of a two tiered C/SSR approach for their Government administered contracts [Ref. 54:p. 14]. However, the key problem in this approach is the determination of application guidance. What threshold guidance should be applied to categorize a project as an upper tier versus a lower tier managed project?

The problem with establishing a threshold value based on a dollar value is that it neglects consideration of a contract's technical risk. For example, a $200 million production type project could have less technical risk than a $125 million production contract, depending on the technology involved. If threshold guidance is specified based on contract risk or

complexity, how does one quantify these factors sufficiently to categorize the project into an upper tier or lower tier managed program? It is the researcher's opinion that the entire tiered concept is not necessary to ensure good non-major project cost and schedule management. The newly established DFARS clause 252.242-7005 provides minimum standards for contractor management systems appropriate for all C/SSR type contracts. This clause emphasizes the most important aspects critical to cost and schedule management, including earned value, and the requirement for a contractor's system to provide for the generation of timely and reliable information for the C/SSR. Earned value (BCWP measurement) is the key to ensuring that reliable information is provided by the contractor regardless of contract size or complexity. According to one experienced C/SSR expert, "Without an accurate BCWP, the report loses much of its utility, cost and schedule variances are not meaningful, trend analysis is unrevealing, and the ability to assess the estimated final cost is diminished" [Ref. 53:p. 3]. Project management emphasis should be placed on earned value measurement and satisfying DFARS clause 252.242-7005 provisions to ensure effective cost and schedule management, rather than to the application of varying degrees of system criteria and formal written management system descriptions, as proposed by the "tiering" concept.

The "tiering" concept does propose one idea that the researcher believes has merit for C/SSR managed projects. A baseline report, similar to format three of the CPR would help the project manager stay attuned to baseline adjustments. Since significant changes to the baseline are an early indication of contract problems, the addition of this format would be valuable [Ref. 53:p. 4]. Baseline changes also can keep cost and schedule variances from emerging until it's too late to do anything about them [Ref. 53:p. 4]. The baseline report would provide the PM the necessary visibility to systematically track baseline changes. The baseline format could be appropriately applied to all C/SSR projects, regardless of dollar value or complexity.

D. THE CONTRACTOR PLANT VISIT

As discussed in Chapter III, "C/SSR Implementation," C/SSR managed contracts require the conduct of a contractor plant visit. The plant visit familiarizes the PM and other Government personnel with the contractor's internal management practices including contractor methodology for determining earned value. Based on many author interviews with both Government and contractor cost and schedule management personnel and PMs, it is the researcher's opinion that plant visits should not be replaced by the formal and comprehensive contractor internal management system validation requirement currently imposed on larger, C/SCSC managed contracts. When

properly planned and executed by knowledgeable Government representatives, the plant visit provides the non-major system PM with sufficient understanding of the contractor's cost and schedule management system to ensure effective project management.

Unfortunately, Government plant visits are not always properly planned and conducted by trained Government representatives. These problems lead to over application of C/SSR requirements, misunderstandings between Government and contractor representatives, and contractor frustration. One method proposed to create uniformity in plant visits is the application of a plant visit checklist. As explained by one Air Force representative from a command that conducts frequent plant visits, "...contractors want to be treated fairly and equally, so we have the need to make some sort of guide so that our teams can apply the same sort of rigor from contractor to contractor, offset somewhat by the scope and dollar amount of the contract" [Ref. 48].

It is the researcher's opinion that extensive checklists are not the solution to plant visit problems. Detailed "yes or no" checklists apply a criteria approach to C/SSR, similar to system validation for major contract management. The C/SSR was designed to be a flexible system, more appropriate for smaller, less costly projects. As one DoD official stated, "checklists are shortcuts to thinking [Ref. 13]." Contractor interviews revealed that contractors also do not believe that

the use of comprehensive checklists will improve plant visits [Ref. 49].

The researcher does believe, however, that some guidance is needed to create a structure and outline for plant visits. This would be particularly helpful for less experienced personnel. The researcher believes that the December 1991 proposed *C/SSR Joint Guide* contains appropriate guidance for Government personnel. The proposed guidance takes the form of an outline of important discussion topics for Government and contractor representatives. Topics include such aspects as developing performance data, subcontractor performance measurement and reporting, direct/indirect cost application, management reserve and undistributed budget uses/controls, control of contract changes, constraints to preclude subjective adjustment of data, and cost/schedule variance analysis [Ref. 15:pp. E-1 through E-10].

The subsections of each topic include questions designed to create a structure for the plant visit, instead of pass or fail criteria. For example, under the topic of developing performance data, one question states, "At what level are actual costs being accumulated [Ref. 15:p. E-4]?" This approach provides structure, yet allows management flexibility based on contract size, risk, and PM requirements. As stated in the proposed guide, "Government representatives should use the outline as a basis for asking questions or prompting

discussions on those management practices which most affect C/SSR reporting [Ref. 15:p. E-1]."

Increased Government training efforts also will improve plant visit planning and execution. Government team representatives must thoroughly understand cost and schedule management concepts in order to adequately investigate contractor internal cost and schedule management systems. This training should be included as part of cost and schedule management course curriculum. Commands also should develop their new, less experienced personnel by pairing them with more senior, trained personnel during plant visits. These efforts will help to ensure that a contractor's management system is capable of generating timely and reliable information for the C/SSR.

E. THE DRAFT *C/SSR JOINT GUIDE* OF 9 DECEMBER 1991

As stated previously in this chapter, the 9 December 1991 *C/SSR Joint Guide* draft is a second attempt to update the antiquated 1978 guide. It is organized into four chapters: general information, implementation actions, reports and their use, and data element explanations. The draft guide also contains six appendices that include helpful information such as abbreviations, definitions, and a copy of the C/SSR report with detailed completion instructions. The appendices also contain guidance for the plant visit and a checklist to aid in the review of the contractor's report. Although this 1991

draft contains more detail than the 1978 guide, it is the researcher's belief that this draft still does not adequately target its audience. Based on the researcher's observations, cost and schedule management training shortfalls exist throughout DoD. Small project offices, with limited personnel, and technically-oriented project managers who are engineers or scientists, are often deficient in cost and schedule management knowledge and application. They may not even view their job as business managers of the project. For example, one major command did not even use the C/SSR as a standard reporting format for applicable non-major contracts. Instead, the command included its own "suggested" format as part of contract RFPs. This example illustrates the need to provide a sufficiently detailed C/SSR guide, targeted at inexperienced personnel, including those in small project offices.

In particular, the 1991 draft guide should include more detailed guidance on C/SSR analysis. The draft guide contains only one paragraph of analysis guidance. Explanations on the calculation and use of cost and schedule performance indices, and the "to complete" performance index would be helpful for the inexperienced analyst. The draft also states that the "tracking of management reserve usage can be an important problem indicator," but does not suggest how to accomplish this [Ref. 15:p. 3-4]. The draft mentions that time history

plots of the data can show important trends, but does not go into the details of trend analysis [Ref. 15:p. 3-4].

The 1991 draft guide contains a complicated chart that shows functional responsibilities of focal points within the three military services and the Defense Logistics Agency (DLA).[3] Unfortunately, focal points within the military services are quite small. For example, the Navy's focal point is only one person! These small focal points severely limit cost and schedule management support available to project offices. The guide does mention that delegation of focal point responsibilities to subordinate organizational elements or agencies will be by formal direction of the major command [Ref. 15:p. 1-4].

It is the researcher's observation that the capabilities of the focal point and the interaction between the focal point and the project office vary greatly between commands. Thus, conclusions in the draft guide indicating that, "the focal point may be requested to provide advice in the C/SSR analysis" and that "the PM should contact the field command focal point for identification of a C/SSR team chief" might be meaningless to project offices assigned to focal points with limited staffing or assistance capability.

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[3]A focal point is that major command responsible for facilitating the appropriate application and implementation of the C/SSR, through policy and procedural guidance and assistance to the PM, the Procuring Contracting Officer (PCO), and the Contract Administration Officer (CAO) [Ref. 15:p. 1-4].

Perhaps, the guide cannot correct what could be interpreted as a military service problem. For the focal points to be useful, they need to be staffed with sufficient trained personnel (based on the number of contracts per command). Their functions, capabilities, and interaction with the project offices also need to be clearly defined and standardized before publication in the *C/SSR Guide*. It would be helpful if focal points could provide C/SSR assistance teams to the project offices as required. The researcher does not believe, however, that the guide should develop into a detailed "cookbook" type approach to the C/SSR because it is important to retain management flexibility in the C/SSR. There is no substitute for management "thinking." The project manager should be able to use good management judgment to tailor C/SSR requirements to his particular project based on his contract risk analysis and management needs. For example, if a contract is 75 percent complete and is meeting cost and schedule targets and will not be modified, what's wrong with a PM suggesting to the contractor that report submission be reduced to bimonthly, or prepared only to WBS level one or two [Ref. 13]?

This type of management understanding, however, can only be attained through effective performance management training and education. Project managers and their staffs must understand report information, report analysis, and the report's use in

project management. To accomplish this, a PM must be actively involved in cost and schedule management on a routine basis.

F. CHAPTER SUMMARY

This chapter provided the history and background of the *C/SSR Joint Guide* revision efforts to date. It also provided an analysis of the C/SSR "tiering" concept and contractor plant visits. Chapter VI also provided an analysis of the 1991 *C/SSR Joint Guide* draft. In addition, the researcher provided recommendations for the improvement of DoD C/SSR management.

Chapter VII will contain a thesis summary, conclusions, and answers to the research questions. The chapter will also contain recommendations and will propose areas for further non-major system cost and schedule management research.

VII. SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND AREAS FOR FURTHER RESEARCH

A. SUMMARY

Although major defense acquisition programs often overshadow non-major programs, non-major acquisitions share similar cost and schedule concerns. As DoD budgets continue their decline, the majority of CPR managed contracts will likely become C/SSR managed contracts. This situation will require increased senior management attention and understanding of the C/SSR management system.

This thesis provided the non-major system project manager with the necessary perspective to help implement and manage non-major project costs and schedules effectively. First, Chapter II provided the reader with a historical perspective of cost and schedule management in DoD and an understanding of the development of the current Cost/Schedule Status Report. It also familiarized the reader with report objectives, key aspects of the C/SSR, and the role of DCAA, DCMAO, and the ACO in non-major system cost and schedule management.

Chapter III described management actions that should be taken during the non-major contract preaward process to ensure adequate initial cost and schedule management and valid C/SSR information. Management decisions made during the preaward process impact the manner, frequency, and level of cost and

schedule data reporting during contract execution. This chapter also discussed the establishment of the performance measurement baseline and contractor measurement of earned value, two key aspects to effective cost and schedule management.

Chapter IV discussed Cost/Schedule Report analysis and management actions the PM can take if a contract is over cost and behind schedule. This chapter also provided the PM an introduction to graphical trend analysis of data. Graphical analysis provides the PM an excellent quantitative visual tool to evaluate cost and schedule management trends. A familiarization with the capabilities of Performance Analyzer software also provides the PM with an understanding of the software's application to performance management. In addition, the chapter discussed over target baseline management.

Chapter V discussed and analyzed the affect that the Navy A-12 Aircraft Program termination has had on the C/SSR environment. This chapter included a review of recent OSD and military service initiatives taken to improve cost and schedule management. It also detailed "lessons learned" from the A-12 termination and provided recommendations for future cost and schedule improvement initiatives.

Chapter VI provided an examination of the proposed *C/SSR Joint Guide* revision including a discussion of a previous revision attempt. This chapter familiarized the reader with the C/SSR "tiering" concept and discussed its potential impact

on C/SSR reporting. It also provided a discussion on the C/SSR contractor plant visit and the researcher's recommendations to improve it. Finally, Chapter VI provided the researcher's recommendations for improving the *C/SSR Joint Guide* draft.

B. ANSWERS AND FINDINGS TO THESIS QUESTIONS

The following are answers to the research questions posed in Chapter I. Where applicable, reference is made to the chapters where a more in-depth discussion can be found.

What should the project manager know to achieve cost and schedule control in non-major Department of Defense acquisitions and what affect has the Cost/Schedule Status Report had on cost and schedule performance?

This thesis focused on many aspects that the non-major system project manager needs to know to achieve effectiveness of project cost and schedule control. First, the PM must clearly understand the objectives of the C/SSR. The C/SSR provides the Government project manager with summary level cost/schedule performance status for early identification of the magnitude and impact of problems having significant cost variances. It also provides the PM objective and quantifiable contract cost and schedule status information for use in decision-making. Finally, it quantifies the effects of management actions taken to resolve existing problems. Chapter II, Section B, discussed C/SSR objectives in detail.

Secondly, the PM should understand the mechanics of the report itself. The PM should be familiar with the four parts of the report: contract report administrative information, contract data, performance data, and narrative explanations. Chapter II, Section C, discussed the mechanics of the C/SSR in detail.

Third, the non-major system PM should understand the differences between the Cost/Schedule Status Report and the Cost Performance Report. Chapter II, Section D discussed these differences. These differences allow the C/SSR to be a flexible, less demanding requirement, more appropriate to smaller projects. The PM should know when the C/SSR should be applied to a project versus the more extensive CPR. Chapter II, Section A provided the thresholds for CPR versus C/SSR application.

Fourth, the non-major system PM should understand how to effectively implement cost and schedule management into his project, including how to utilize DCAA, DCMAO, and ACO personnel to assist in this effort. The researcher found that these assets are often underutilized by PMs. Since these agencies are often located close to the contractor plant, they can provide the PM with timely, first-hand, on-site investigation of contractor cost and schedule management. DCAA, DCMAO, and ACO responsibilities in cost and schedule management were discussed in Chapter II, Section E. DCMAO surveillance responsibilities should be detailed in a Memorandum of

Agreement between the PM and DCMAO Program and Technical Support personnel assigned as matrix support. Chapter III, Section J, discussed the Memorandum of Agreement in detail.

The PM needs to understand the importance of proactive PM involvement during the contract preaward process. The researcher found that the preaward phase of C/SSR implementation is key to project cost and schedule management. Management decisions made during this phase impact the manner, frequency, and level of cost and schedule data reporting during contract execution. Actions that impact project cost and schedule management included during the preaward phase are the development of the contract statement of work, contract work breakdown structure and variance thresholds. Chapter III, Sections B, C, and D discussed these aspects in detail.

The PM also needs to understand initial contractor actions that affect project cost and schedule management. This includes the establishment of the performance measurement baseline, against which project performance is measured. Also, once the baseline is established, it is equally important to maintain its integrity in order to generate accurate cost and schedule information. Baseline changes should be managed and controlled by the contractor. Chapter III, Sections G, discussed the development and maintenance of the performance measurement baseline in detail.

Fifth, the PM needs to understand the purpose of the contractor plant visit. This visit provides the project

manager and his staff with a basic understanding of the methods by which the contractor plans the work, controls project resources, evaluates project accomplishment, measures cost/schedule performance, collects costs, and incorporates contract changes into the baseline. Most importantly, the plant visit provides the opportunity for Government representatives to gain an understanding of the contractor's methodology for measuring earned value. Chapter III, Sections H and I addressed these subjects in detail.

Since the contractor plant visit provides the PM valuable contractor cost and schedule management information, it is important that Government team representatives be well trained in plant visit execution. The researcher found that this is often not the case, resulting in overapplication of C/SSR requirements, misunderstandings between Government and contractor representatives, and contractor frustration. Chapter VI, Section D, discussed this issue and proposed solutions to this problem.

Sixth, the PM needs to understand how the C/SSR is analyzed and how analysis can be used for project cost and schedule management. Chapter IV, Sections B, C, D, E, and F provided performance factors, indices, and other analytical techniques and performance indicators helpful in C/SSR analysis. The PM should understand how to use graphical, trend analysis and Performance Management software as tools to evaluate project

cost and schedule management. Chapter IV, Sections E and F, discussed these aspects in detail.

The researcher discovered that PMs and their staffs are often weak in this aspect of C/SSR management. It is important for cost and schedule managers to understand the meaning of the various performance factors and indices, in addition to understanding their calculation. Education and training shortfalls throughout DoD have contributed to this problem. Chapter V adressed training shortfalls and on-going initiatives to correct this problem.

The PM also needs to be familiar with various management actions available for use when cost and schedule problems arise. The PM needs to ensure that he clearly understands the nature of the problem and that he is satisfied with explanations provided by the contractor for all variances exceeding thresholds. The PM should also understand the advantages and disadvantages of withholding contractor progress payments. Chapter IV, Section G, discussed management aspects available to the PM in detail.

Seventh, the PM needs to understand the affect that reprogramming and replanning have on cost and schedule management. Both reprogramming and replanning affect the performance measurement baseline and must be carefully managed to prevent distortions in cost and schedule management reporting. Chapter III, Section G, discussed replanning while Chapter IV, Section H, discussed reprogramming.

Eighth, the PM needs to understand how the A-12's termination has affected DoD cost and schedule management. Initiatives taken by the three military services and DoD have implications for non-major program management. Specifically, how OSD and service-initiated training reforms will provide an opportunity to improve cost and schedule management education for all programs. Also, a heightened management interest in performance analysis by Mr. Yockey is likely to result in increased management attention toward cost and schedule management in all DoD programs. Chapter V discussed these initiatives and their implications for non-major cost and schedule management.

Finally, the non-major system PM should have an understanding of on-going efforts to revise the *C/SSR Joint Guide*. The PM needs to understand the implications of proposed changes to non-major system project management. Chapter VI discussed these aspects in detail and provided suggestions to improve non-major cost and schedule management.

Overall, the Cost/Schedule Status Report has had a positive influence on cost and schedule management within the Department of Defense. When used properly by trained personnel, it provides the non-major system project manager with an excellent project management tool. Unfortunately, it is sometimes viewed by PMs as only a "required report" versus a management tool. This attitude prevents the PM from fully realizing the value of the report in project management. To fully integrate

earned value into project management, the PM must incorporate report information into management decision making. This requires the PM to actively question contractor narratives, report analysis, and contractor corrective actions.

Unfortunately, PMs and staffs within non-major programs are often inexperienced and not well-trained in cost and schedule management. Some engineers and scientists assigned as project managers do not even view cost and schedule management as part of their duty. These attitudes need to be overcome in order for the C/SSR to fully be utilized as an effective performance management tool.

What are the key aspects of the Cost/Schedule Status Report (C/SSR)?

The C/SSR consists of four parts: contractor report administrative information, contract data, performance data, and narrative explanations. The short administrative section includes information on the contract type, project name, contractor name and location, report period, and signature of the contractor's authorized representative who prepared the report.

The contract data section establishes the overall contract values. This value serves as a cost baseline for the purposes of cost performance measurement. The C/SSR performance data section depicts contract cost status for the specified cost work breakdown structure elements on a cumulative basis and as estimated at completion.

Narrative explanations are included as a separate portion of the C/SSR when work breakdown structure variances exceed established thresholds. Chapter II, Section C provided a detailed explanation of all items contained in the C/SSR.

How does non-major acquisition cost/schedule management differ from major system acquisition cost/schedule management? How is it similar?

Non-major acquisition cost and schedule management has more flexible, less demanding, and less costly reporting requirements than major acquisition cost and schedule management. Non-major acquisitions that require cost and schedule reporting (as specified in DoDI 5000.2, *Defense Acquisition Management Policies and Procedures*) use the abbreviated two format Cost/Schedule Status Report (C/SSR). Major acquisitions that require cost and schedule reporting use the five format Cost Performance Report (CPR). The C/SSR contains a format similar to format one of the CPR, but contains only cumulative data, vice current period data required by the CPR. The C/SSR also does not require the functional performance reporting, manloading projections, and baseline reporting required by the CPR. Both reports contain a contractor narrative explaining overall contract performance and significant variance(s) explanation.

The CPR also requires the budgeted cost of work scheduled (BCWS) and budgeted cost of work performed (BCWP) to be calculated as a direct summation of work package budgets. The

C/SSR is more flexible and permits the determination of these values through any reasonably accurate, consistent, and mutually agreed to means.

Finally, the C/SSR does not require a formal Government validation of a contractor's internal cost and schedule management system. Instead, it only requires a contractor plant visit by Government representatives to familiarize project management personnel with the contractor's internal management systems. Both systems, however, require the contractor to use consistent and objective measures for collecting and reporting cost and schedule information. Chapter II, Section D, discussed this section in detail.

How does the project manager use the data provided in the Cost/Schedule Status Report?

The C/SSR provides the Government project manager with objective contractor performance status for early identification of cost and schedule problems. Report analysis allows the PM to make management decisions and to take timely corrective action to improve contractor performance. Report trend analysis allows the project manager to evaluate the effects of corrective actions by indicating whether cost and schedule variances are improving or getting worse. Trend analysis also provides the PM with a forecast of the estimated cost of the project at completion. Chapter IV provided the reader with information on how to conduct C/SSR analysis and trend analysis. It also described appropriate management

actions the PM can take if a project is over cost or behind schedule.

How does the Government set an appropriate threshold to measure cost/schedule variance?

There are several approaches that can be used by the PM to determine appropriate variance thresholds. In all cases, the project manager should consider the contract's size and risk when choosing a threshold percentage and a dollar minimum. The PM also should include in the contract request for proposal a requirement for periodic variance threshold reviews, enabling the PM to adjust thresholds based on management information needs.

Often thresholds are established based on a certain percentage of BCWP or BCWS and/or an established dollar minimum. Any cost and schedule variance that exceeds the threshold would require contractor variance analysis and narrative explanation.

One simple approach sometimes used in setting thresholds is for the PM to establish a fixed number of variances for the contractor to report. This approach ensures the project manager is receiving a manageable amount of contractor narrative explanations, while ensuring visibility over the most important project problems.

Another approach is for the PM to specify narrative reporting for only critical items that exceed thresholds. Risk analysis determines the critical cost and schedule

drivers. One variation to this approach is to set lower thresholds on critical items and higher thresholds for less critical items. Chapter III, Section D, discussed this topic in detail.

Since C/SSR does not require the evaluation or acceptance of a contractor's internal management procedures, what problems does this create?

When properly planned and conducted by trained Government representatives, the plant visit provides the non-major system PM with sufficient understanding of the contractor's cost and schedule management system to ensure effective project management. The problem is that Government representatives are not always well-trained in the conduct of plant visits. This problem leads to over application of C/SSR requirements, misunderstandings between Government and contractor representatives, and contractor frustration. The researcher believes that the December 1991 proposed *C/SSR Joint Guide* contains appropriate guidance to structure contractor plant visits and assist Government representatives. Chapter VI, Section D, discussed this subject in detail.

What is meant by rebaselining and what effect does it have on the C/SSR?

Rebaselining refers to contractor replanning or reprogramming actions. Replanning is a change in the original baseline for accomplishing authorized contractual requirements. The contractor can replan work as long as he stays within the

contract target cost or estimated cost, and completes all work by the contractual completion date. Without a tight discipline of changes, any established baseline will be lost, creating problems in accurate cost and schedule management reporting. Chapter III, Section G, discussed contractor replanning in detail.

Reprogramming, or an over target baseline is when a contractor requests approval to manage to a goal above the contract target cost. It results in the contractor's total allocated budget exceeding his contract budget base, and results in a major restructuring of contractor efforts. Reprogramming is a formal declaration of a contract overrun by the contractor.

Reprogramming results in major changes to the baseline. It also results in the resetting of cost and schedule variances to zero. Essentially, the C/SSR is "restarted" to represent the new over target baseline management. The PM can retain visibility of old problems through the contractor's submission of a latest revised estimate with his C/SSR, through the development of a ratio between the total allocated budget before reprogramming and the total allocated budget after reprogramming, or by requiring contractor reprogramming adjustment reporting. Chapter IV, Section H, discussed these aspects of reprogramming in detail.

How should the C/SSR be changed to retain adequate uniformity in reporting requirements while allowing the project manager flexibility to tailor requirements based on contract size and complexity?

The C/SSR should include baseline reporting, similar to format three of the CPR. This would help the project manager stay attuned to baseline adjustments. The *C/SSR Joint Guide* also should contain additional detail and guidance, particularly on C/SSR analysis, to assist inexperienced cost and schedule managers. In addition, DoD/military department focal point responsibilities and staffing requirements should be reassessed by the OSD staff and the military services. Their functions, capabilities, and interaction with the project offices also need to be clearly defined and standardized prior to their publication in the *C/SSR Guide*.

The researcher does not believe that the *C/SSR Guide* should take a detailed "cookbook" type approach. A "cookbook" type approach would reduce management flexibility and discourage individual "thinking." The researcher believes, however, that management flexibility and "thinking" can only be attained through effective performance management education offered through DSMC and AFIT, including an understanding of report information, report analysis, and the report's use in project management. This topic was discussed in detail in Chapter VI, Section E.

How has the Navy's A-12 program cancellation affected the C/SSR environment? Are there any applicable lessons learned?

The Navy's A-12 program cancellation has led to a heightened OSD interest in cost and schedule management and a number of actions throughout DoD to strengthen cost and schedule control practices. Although there have been no specific actions directed solely at non-major projects, there have been many reforms initiated by all three military services and OSD, that have affected the entire cost and schedule control community, including non-major acquisitions.

Mr. Yockey's personal interest in promoting the use of earned value in DoD project management has resulted in a renewed interest in its use throughout the DoD acquisition community. He has emphasized the need for increased management training and has created a new billet within the Office of Acquisition Policy, Program Integration and Cost Management to improve cost and schedule management education. Training review efforts have contributed to the publication of three key Department of Defense publications as discussed in Chapter V, Section B. A detailed OSD-led review of DoD acquisition training and education at DSMC and AFIT has also revealed shortfalls in earned value education, including course funding and course content. Actions to improve these shortfalls are currently being addressed at the OSD level. In addition, Mr. Yockey's interest in cost and schedule analysis has resulted

in the formation of a Tri-Service and DLA panel for Performance Analyzer software.

Navy initiatives since the A-12 termination have focused on the development of a Revitalization Plan to improve Navy cost and schedule management. The Cost Performance Analysis Working Group chartered to develop this plan identified twenty-two recommendations to strengthen performance management. Chapter V, Section C, discussed these recommendations which are currently awaiting final review and approval by the Assistant Secretary of the Navy (RD&A). Various Naval System Commands have also initiated actions to improve cost and schedule management education as discussed in Chapter V, Section C. As recommended by the researcher, these Navy-initiated courses should be assimilated as part of the Defense Acquisition University structure.

Army initiatives since the A-12 termination have focused on a study of current Army performance management practices. This study resulted in the approval, by the Army Acquisition Executive, of three recommendations to improve performance management practices within the Army. Chapter V, Section D discussed these recommendations. Mr. Conver, the Army Aquisition Executive, also expressed his concern about cost and schedule management in both the September-October 1991 and November-December 1991 issues of the *Army Research, Development, & Acquisition Bulletin*.

Air Force initiatives have focused on experimenting with acquisition innovations, specifically within its F-22, Advanced Tactical Fighter Aircraft Program. Chapter V, Section E discussed these initiatives. Lessons learned on this program are likely to result in future initiatives benefiting all projects. The Air Force Systems Command has also taken several initiatives to promote performance management as discussed in Chapter V, Section E.

Chapter V, Section E, discussed "lessons learned" from the A-12 termination. The "lessons learned" included a recognition of the lack of coordinated cost and schedule management training effort throughout DoD. A coordinated OSD-led focus is currently in progress to correct this deficiency.

Another A-12 termination "lesson learned" found by the researcher is that a project manager emphasizes aspects that he feels his boss is most concerned with, or that the PM is most "comfortable" with. Cost and schedule management is often not one of these aspects, particularly in small projects. If cost and schedule analysis is not routinely used throughout the larger program management chain of command, there is no guarantee that it will be used among lower level project managers. For performance management to be effective, senior managers must understand its principles and make the right "informed" decision, including terminating projects for cost and schedule management problems, when justified.

C. RECOMMENDATIONS

DoD should require the contractor to submit a baseline report as part of the contractor's monthly C/SSR.

A baseline report, similar to format three of the CPR, would help the project manager stay attuned to baseline adjustments. Since significant baseline changes are often an early indication of contract problems, the addition of this format would be extremely helpful. This format could be appropriately applied to all C/SSR projects, regardless of dollar value or complexity.

The proposed December 1991 *C/SSR Joint Guide* should be revised toward providing adequate cost and schedule management guidance for inexperienced personnel.

Since performance management education shortfalls exist throughout DoD, the guide should be tailored toward providing the necessary cost and schedule management guidance for inexperienced personnel. Specifically, the guide should contain more detail on C/SSR analysis. However, the researcher believes that the proposed guide contains appropriate guidance to structure and improve contractor plant visits.

Focal point staffing within the military services should be increased to provide the capability to provide assistance to non-major system project offices in the areas of C/SSR implementation, plant visits, and C/SSR analysis.

Focal points within the many commands and services are insufficiently staffed to provide any comprehensive assistance

to non-major system project offices. Also, their functions, capabilities, and interaction with the project offices are often ill-defined and vary greatly between commands and services. For the focal points to be useful, they need to be staffed with sufficiently trained personnel i.e., based on the number of contracts per command or number of projects. The focal points should be capable of providing C/SSR expertise to the non-major system PM, as required. This would provide a strong service and central point of contact for C/SSR issues and problems within the various military commands.

DoD should develop and publish a DoD *Best Practices* Manual for cost and schedule management.

This manual would provide a valuable tool for all PMs, their staffs, contracting officers, DCMAO/DPRO personnel, and other acquisition personnel, on cost and schedule management issues. It would be particularly useful for inexperienced personnel. This manual could incorporate cost and schedule management "lessons learned" from throughout DoD, providing an opportunity to prevent future, similar problems.

The manual could be structured similar to the existing Navy *Best Practices* Manual used for reliability, maintainability, and quality assurance. The manual should identify "traps" to avoid in cost and schedule management, "alarms" or warning signs of impending traps, and consequences that can result from the traps. It also should provide recommended "escapes" from traps, and the benefits associated with these escapes.

Training innovations need to be explored and implemented throughout DoD.

Declining military budgets will demand training innovation. One approach is a requirement for students to complete a basic cost and schedule control familiarization correspondence course as a prerequisite to attendance at a formal DoD performance management school. This would allow resident classtime to focus on more complex or detailed aspects of cost and schedule management, while ensuring a foundation of knowledge for all students. Video and satellite technology should also be used in cost and schedule management education. The use of this technology would allow more students to participate in training, while reducing expensive travel costs.

DoD also should implement periodic on-site assistance seminars at major service acquisition commands. These seminars could be taught by a cadre of experienced performance management instructors from AFIT, DSMC, former PMs, or other cost and schedule control experts, or contracted out to civilian cost and schedule management consultants. Consideration also should be given to allowing contractor PMs and their staffs to attend the training. This would further cost and schedule management communication and understanding between the Government and the contractor, providing the potential for improved reporting and earned value management.

In all approaches, training efforts should include the education of engineers and scientists assigned non-major project management responsibility. Often, these personnel do not receive any formal performance management training. As one result of this lack of training, many engineers and scientists assigned as non-major acquisition project managers view their responsibilities in terms of meeting technical requirements and not in terms of managing cost and schedule.

D. AREAS FOR FURTHER RESEARCH

Further research should focus on a detailed examination of C/SSR application within a particular Army subordinate command such as the Aviation Systems Command or Communications and Electronics Systems Command. This narrower focus would allow the researcher to explore C/SSR implementation and application in depth. This research would provide these commands with an independent assessment of their C/SSR management. This assessment could be used by the commands to improve cost and schedule management within their non-major system acquisitions.

Another area for further research would be an investigation of the potential for earned value application and C/SSR use within Government activities including depots, proving grounds, and laboratories [Ref. 55]. These agencies often have contractual relationships with project offices, providing them with Government furnished equipment, research studies,

etc. Often, these contracts fall within a dollar range applicable for C/SSR management. Unfortunately, however, cost/schedule status reporting is not currently required between Government agencies. As a result, project managers are only provided cost estimates and cost actuals for depot, lab, or proving ground work, and have no method to determine earned value during work execution. Since earned value is a good management tool and is required of contractors, it would make sense to implement it within these Government activities.

This research also should include a survey of depots, proving grounds and laboratories to determine personnel knowledge and use of earned value. The research should determine how these activities presently estimate and manage cost and schedule performance. Finally, the research should provide a recommendation as to whether it is feasible to implement the C/SSR within depots, proving grounds, and laboratories. If earned value application is feasible, the researcher should also provide recommendations on how, and to what extent, it should be implemented within these Government activities. [Ref. 55]

APPENDIX A

DEFINITIONS

Actual Cost of Work Performed (ACWP)- The cumulative actual costs (direct and indirect) of work accomplished as of the reporting cut-off date listed by each work breakdown structure element [Ref. 56:p. B-3].

At Completion-Budgeted- The total budget identified to each work breakdown structure element (including any contract changes, application of management reserve, or internal replanning [Ref. 2:p. E-3].

At Completion-Variance- The difference between the Budgeted Cost at Completion and the Latest Revised Estimate [Ref. 2:p. E-3].

Budgeted Cost of Work Performed (BCWP)- The sum of the budgets for completed work packages and completed portions of open work packages, plus the appropriate portion of the budgets for level of effort and apportioned effort. Also known as earned value [Ref. 16:p. 504].

Budgeted Cost of Work Scheduled (BCWS)- The sum of the budgets for all work scheduled to be accomplished within a given time period [Ref. 16:p. 504].

Buy-in- Submission of an offer by a contractor, usually substantially below estimated cost, with the expectation of winning the contract [Ref. 56:p. B-13].

Contract Budget Base- The sum of the current target cost and the estimate of authorized, unpriced work [Ref. 56:p. B-19].

Contract Data Requirements List (CDRL)- A listing of data requirements specified for a contract [Ref. 56:p. 505].

Contract Target Cost- The negotiated estimated cost excluding profit or fee [Ref. 16:p. 505].

Contract Target Price- The negotiated estimated cost including profit or fee [Ref. 16:p. 505].

Cost Account- An identified management control point at which actual costs can be accumulated and compared to budgeted cost for work performed. It represents the work assigned to one

responsible organizational element on the contract work breakdown structure [Ref. 16:p. 505].

Cost Performance Report- A Department of Defense management report generated by the contractor and utilized by a project manager to manage cost and schedule status on major (or significant) contracts [Ref. 16:p. 507].

Cost/Schedule Status Report (C/SSR)- A Department of Defense management report generated by the contractor and utilized by a project manager to manage cost and schedule status on non-major contracts [Ref. 16:p. 507].

Cost Variance (CV)- The difference between the Budgeted Cost of Work Performed and the Actual Cost of Work Performed. [Ref. 2:p. E-3].

Estimate at Completion (EAC)- Actual direct and applied indirect costs of a contract to date, plus the estimate of costs for authorized work remaining [Ref. 16:p. 509].

Focal Point- Major command responsible for facilitating the appropriate application and implementation of the C/SSR, through policy and procedural guidance and assistance to the PM, procuring contracting officer, and the administrative contracting officer [Ref. 15:p. 1-4].

General and Administrative (G & A)- Indirect costs incurred in the general management of the company, not related to product output [Ref. 16:p.511].

Latest Revised Estimate (LRE)- The total dollar value of work to date plus the contractor's estimate of the cost for work remaining listed by work breakdown structure element. [Ref. 2:p. E-3].

Management Reserve- The portion of the contract budget base that is held for management control purposes by the contractor to cover the expense of unanticipated program requirements [Ref.2:p. E-4].

Non-major contract- A research, development, test, or development, test, or evaluation contract with a value of less than $60 million, or a procurement contract with a value of less than $250 million (in fiscal year 1990 constant dollars). Also referred to as a less than significant contract [Ref. 6:p. 11-B-2].

Performance Measurement Baseline (PMB)- The time phased budget plan developed by the contractor against which project performance is measured [Ref. 16:p. 515].

Progress Payments- Payments made to a prime contractor, normally on a fixed-price type contract, on the basis of a percentage of his incurred costs [Ref. 16:p. 517].

Reprogramming- The baseline rebudgeting activity which occurs when the contractor formally notifies the PM that the Total Allocated Budget must exceed the Contract Budget Base. Essentially, it is a recognition by the contractor of a contract overrun [Ref.22:p. 15].

Request for Proposal (RFP)- A soliciatation document used to request proposals from potential contractors [Ref. 56:p. B-95].

Subsequent Application Review (SAR)- Visit by Government personnel to a contractor's facility to determine whether the contractor has properly applied the management control system previously accepted as meeting the requirements of C/SCSC to a new contract [Ref. 16:p. 520].

Schedule Variance (SV)- The difference between the Budgeted Cost for Work Scheduled and the Budgeted Cost for Work Performed [Ref. 16:p. 519].

Statement of Work- That portion of a contract which establishes and defines all non-specification requirements, either directly or by cited documents [Ref. 56:p. B-105].

Thresholds- Monetary or time reference points determined by the government project manager to track contract progress, which if breached, require analysis by the contractor. [Ref. 16:p. 521].

Undistributed Budget- The amount of budget applicable to the contract which has not been identified to work breakdown structure elements at or below the reporting level [Rf. 16:p. 521].

Work Breakdown Structure- A family tree division of hardware, software, services, and project tasks which organizes, defines, and graphically displays the product to be produced, as well as the work to be accomplished to achieve the specified product. Also called the contract work breakdown structure [Ref. 16p: 522].

Work Packages- Detailed short span jobs, or material items which have assigned budgets for accomplishing the work required to complete the contract [Ref. 16:p. 522].

APPENDIX B

ABBREVIATIONS

AAE- Army Acquisition Executive [Ref. 56:p. A-1].

ACAT- Acquisition Category [Ref. 56:p. A-1].

ACO- Administrative Contracting Officer [Ref. 56:p. A-1].

ACWP- Actual Cost of Work Performed [Ref. 56:p. A-1].

AFIT- Air Force Institute of Technology [Ref. 56:p. A-1].

ASN (RD&A)- Assistant Secretary of the Navy, Research, Development, and Acquisition [Ref. 56:p. A-2].

BAC- Budget at Completion [Ref. 56:p. A-3].

BCWP- Budgeted Cost of Work Performed [Ref. 56:p. A-3].

BCWS- Budgeted Cost of Work Scheduled [Ref. 56:p. A-3].

CAO- Contract Administration Office [Ref. 56:p.A-3].

CBB- Contract Budget Base [Ref. 16:p. 505].

CDRL- Contract Data Requirements List [Ref. 16:p. 505].

CEO- Chief Executive Officer [Ref. 56:p. A-4].

CPAWG- Cost Performance Analysis Working Group [Ref. 40:p. 4].

CPI- Cost Performance Index [Ref. 16:p. 507].

CWBS- Contract Work Breakdown Structure [Ref. 16:p. 507].

CPR- Cost Performance Report [Ref. 16:p. 507].

C/SCSC- Cost/Schedule Control Systems Criteria [Ref. 16:p. 507].

C/SSR- Cost/Schedule Status Report [Ref. 16:p. 507].

CV- Cost Variance [Ref. 16:p. 507].

DCAA- Defense Contract Audit Agency [Ref. 56:p. A-5].

DCMAO- Defense Contract Management Area Operations [Ref. 56:p. A-5].

DCMC- Defense Contract Management Command [Ref. 56:p. A-5].

DFARS- Defense Federal Acquisition Regulation Supplement [Ref. 56:p. A-6].

DLA- Defense Logistics Agency [Ref. 56:p. A-6].

DPRO- Defense Plant Representative Office [Ref. 56:p. A-6].

DSMC- Defense Systems Management College [Ref. 56:p. A-6].

DTIC- Defense Technical Information Center [Ref. 56:p. A-7].

EAC- Estimate at Completion [Ref. 56:p. A-7].

ETC- Estimate to Completion [Ref. 16:p. 509].

FAR- Federal Acquisition Regulation [Ref. 56:p. A-7].

G&A- General and Administrative [Ref. 16:p. 511].

GFE- Government Furnished Equipment [Ref. 56:p. A-8].

LRE- Latest Revised Estimate [Ref. 56:p. A-11].

MOA- Memorandum of Agreement [Ref. 56:p. A-11].

NAVAIR- Naval Air Systems Command [Ref. 56:p. A-12].

NAVSEA- Naval Sea Systems Command [Ref. 56:p. A-12].

OSD- Office of the Secretary of Defense [Ref. 56:p. A-14].

OTB- Over Target Baseline [Ref. 16:p. 515].

PA- Performance Analyzer [Ref. 29:p. 1].

PAT- Process Action Team [Ref. 48].

PEO- Program Executive Officer [Ref. 56:p. A-14].

PERT- Program Evaluation and Review Technique [Ref. 56:p. A-14].

PMB- Performance Measurement Baseline [Ref. 16:p. 516].

PM- Project or Program Manager [Ref. 56:p. 516].

PMJEG- Performance Measurement Joint Executive Group [Ref. 16:p. 516].

R&D- Research and Development [Ref. 56:p. A-16].

RFP- Request for Proposal [Ref. 56:p. A-16].

SARDA- Assistant Secretary of the Army, Research, Development, and Acquisition [Ref. 42].

SPI- Schedule Performance Index [Ref. 16:p. 261].

SV- Schedule Variance [Ref. 16:p. 520].

SOW- Statement of Work [Ref. 56:p. A-17].

SYSCOMS - Systems Commands [Ref. 56:p. A-18].

TAB- Total Allocated Budget [Ref. 16:p. 520].

TCPI- To Complete Performance Index [Ref. 16:p. 521].

TQM- Total Quality Management [Ref. 56:p. A-19].

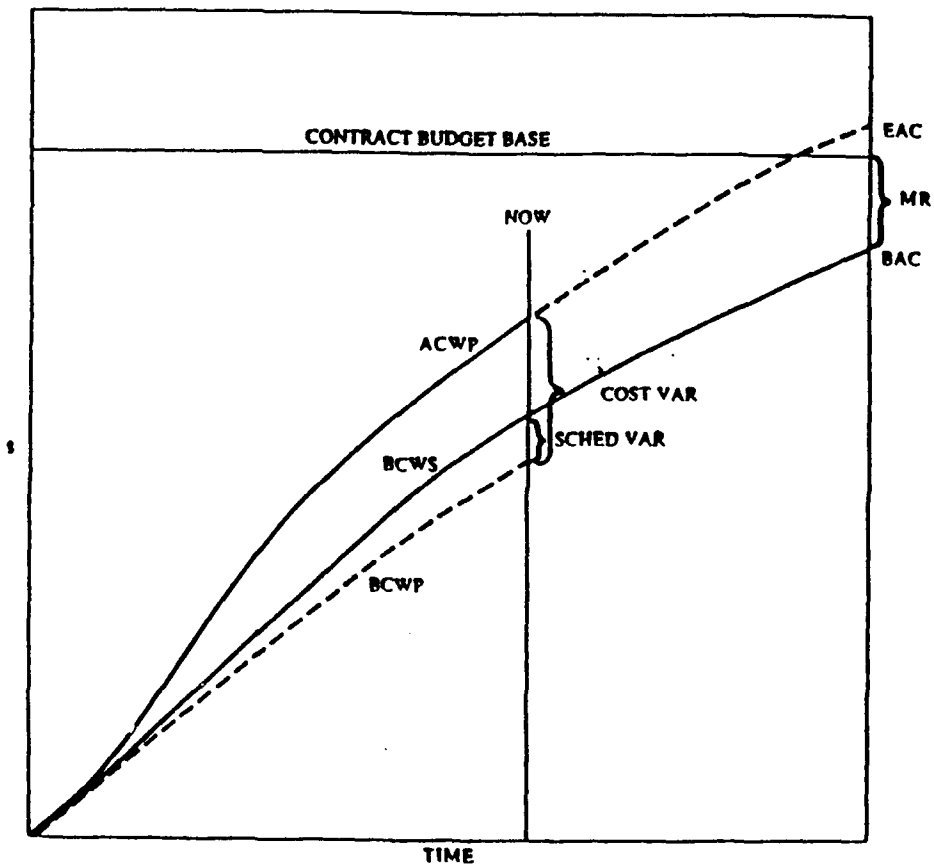
USD(A)- Under Secretary of Defense (Acquisition) [Ref. 56:p. A-19].

VAC- Variance at Completion [Ref. 16:p. 521].

WBS- Work Breakdown Structure [Ref. 16:p. 522].

APPENDIX C

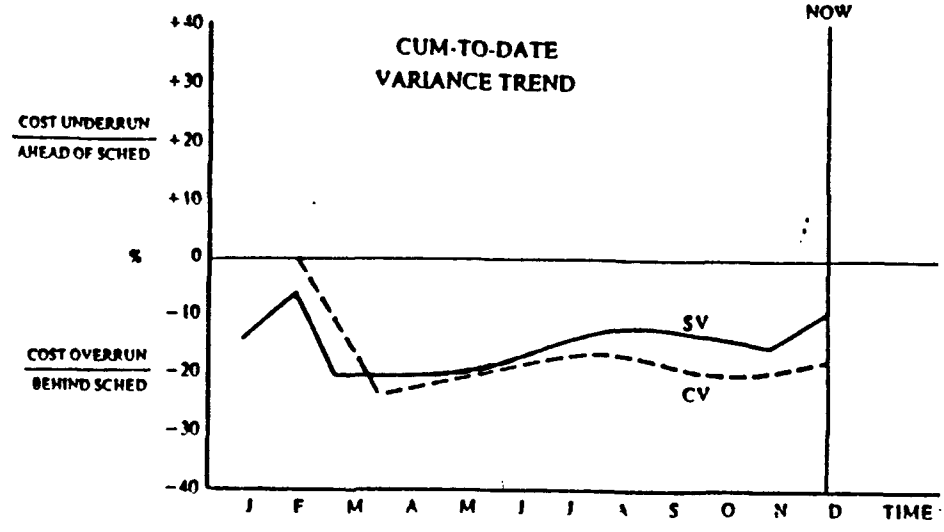
CUMULATIVE PLAN/STATUS GRAPH

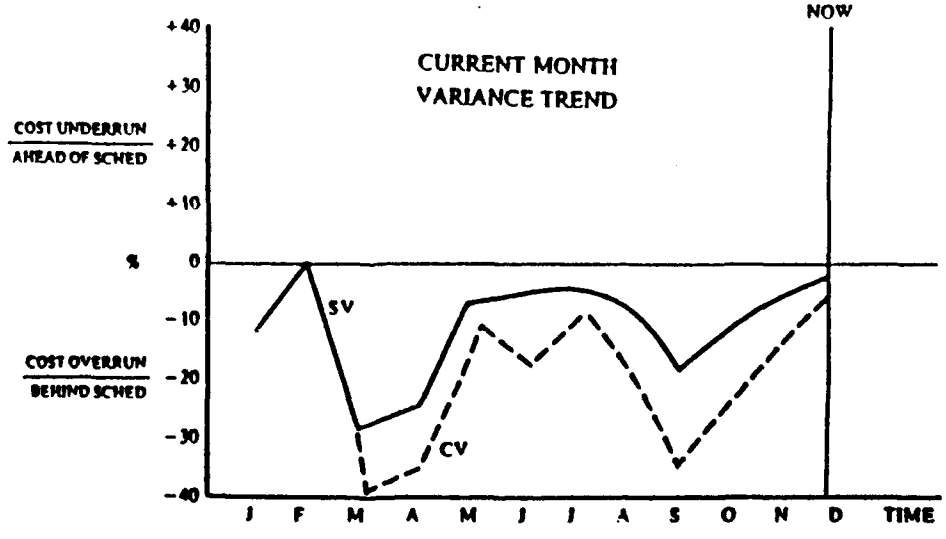


MR- Management Reserve
EAC- Estimate at Completion
BAC- Budget at Completion
ACWP- Actual Cost of Work Performed
BCWP- Budgeted Cost of Work Performed
BCWS- Budgeted Cost of Work Scheduled

APPENDIX D

COST AND SCHEDULE VARIANCE TRENDS GRAPHS



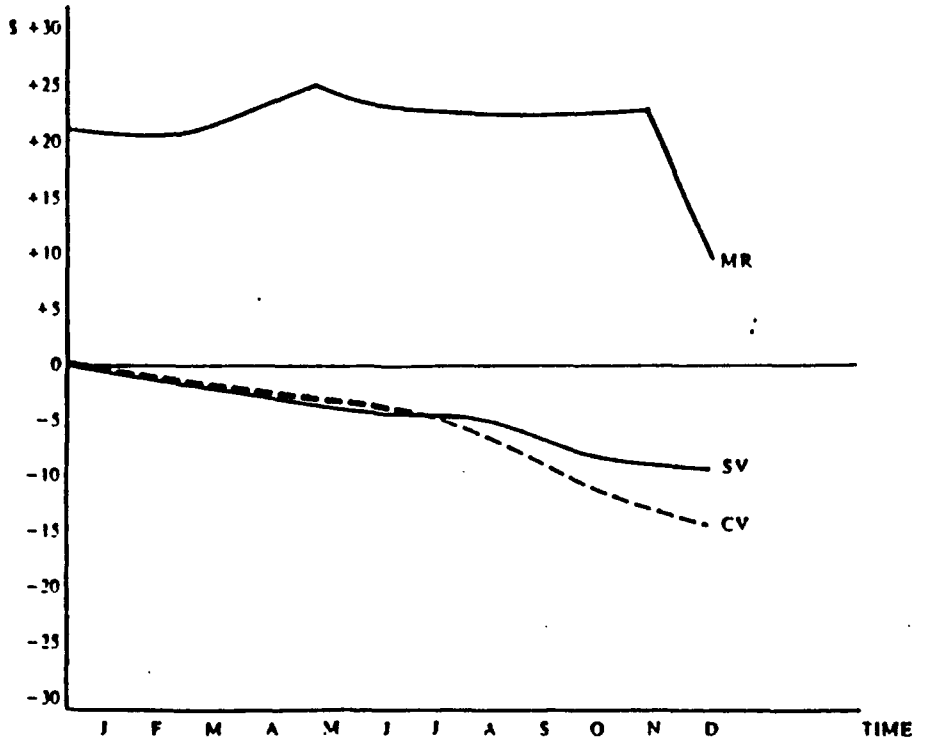


SV- Schedule Variance

CV- Cost Variance

APPENDIX E

MANAGEMENT RESERVE VS COST AND SCHEDULE VARIANCES GRAPH



MR- Management Reserve
SV- Schedule Variance
CV- Cost Variance

APPENDIX F

INTERVIEWS

Interview between Mr. Wayne Abba, Program Analyst, Office of the Under Secretary of Defense (Acquisition), and the researcher, 21 August 1991.

Interview between MAJ Bruce Barrie, USAF, Course Director, Contractor Performance Management Course, Defense Systems Management College, and the researcher, 19 August 1991.

Interview between Ms. Michelle Bell, Cost Analyst, Air Force Systems Command, and the researcher, 29 October 1992.

Telephonic interview with Mr. Darrell Blackburn, Manager Group Earned Value, Motorola Inc., and the researcher, 13 February 1992.

Interview between LTC Thomas Bowman, USAF, Air Force Aeronautical Systems Division Focal Point for C/SCSC, Scheduling, and WBS, and the researcher, 22 August 1991.

Interview between Mr. Larry Brewer, President, Brewer and Brewer Inc. Automated Systems, and the researcher, 29 October 1991.

Interview between MAJ David Christianson, USAF, Professor, Cost Management, Air Force Institute of Technology, and the researcher, 22 August 1991.

Interview between Mrs. Adeliza Cordis, Chief Systems Engineering Branch, Defense Contract Management Area Operation, San Francisco, and the researcher, 26 April 1991.

Telephonic interview between COL Ronald P. Daigler, USAF, PMJEG Focal Point, and the researcher, December 1991.

Interview between Mr. R.L. Endicott, Office of the Assistant Secretary of the Army, RD&A, and the researcher, 4 February 1992.

Interview between Mr. Irwin J. Faibisch, Chief, Contractor Program Management, National Security Agency, and the researcher, 4 February 1992.

Interview between Mr. Daniel Gonzolez, Contract Specialist, Defense Nuclear Agency, and the researcher, 31 October 1992.

Interview between BG Otto J. Guenther, U.S. Army, Program Executive Officer, Communications Systems, and the researcher, 29 January 1992.

Interview between LTC Hauck, Cost/Schedule Department Chairman, Defense Systems Management College, and the researcher, 19 August 1991.

Telephonic interview between COL Leland H. Hewitt, U.S. Army, Project Manager, Army Data Distribution System, and the researcher, 28 October 1991.

Interview between LTC John W. Hogrebe, USAF, Chief, Cost Information and Systems Management Division, Air Force Systems Command, and the researcher, 30 October 1991.

Telephonic interview between Mr. Bob Kemps, C/SCSC consultant, Humphreys and Associates, and the researcher, 10 February 1992.

Interview between Ms. Shamim Khan, Surveillance Monitor, Defense Contract Management Area Operation, San Francisco, and the researcher, June 1991.

Telephonic interview between Mr. Ed Martin, Project Manager, AN/ALR-62 Radar, and the researcher, 9 July 1991.

Telephonic interview between Mr. Jeri Napi, Cost Analyst, Army Data Distribution System, and the author, October 1991.

Interview between Mr. Harold W. Nelson, Project Manager, Ebasco Services, and the researcher, 18 August 1991.

Interview between CPT Pete Regen, USAF, Administrative Contracting Officer, Defense Contract Management Area Operation, and the researcher, June 1992.

Interview between LTC Bob Reuter, U.S. Army, Office of Acquisition Policy, Program Integration, and Cost Management, and the researcher, 31 January 1992.

Interview between Mr. Dave Robertson, Management Analyst, Defense Contract Management Command, and the researcher, 30 October 1991.

Interview between Mr. Chuck Sell, U.S. Navy C/SCSC focal point, and the researcher, 20 August 1991.

Interview between Mr. Larry Stone, Chief of the Contract Cost Performance Division, Deputy Chief of Staff for Resource Management, HQ, U.S. Army Materiel Command, and the researcher, 20 August 1991.

Interview between Mr. Rick Sylvest Assistant Deputy Director for Acquisition Policy, Offi.. of the Secretary of Defense (Acquisition), and the researcher, 15 August 1991.

Interview between Ms. Francis Velore, Professor, Cost Performance Measurement Curriculum, Defense Systems Management College, and the researcher, 20 August 1991.

Interview between RADM William Vincent, U.S. Navy, Commandant, Defense Systems Management College, and the researcher, 5 February 1992.

Interview between MAJ Wolosz, USAF, Cost Management Division, Wright-Patterson Laboratory Command, and the researcher, 22 August 1992.

APPENDIX G

WORKSHOP ATTENDED

Cost/Schedule Control Systems Criteria National Workshop, Falls Church, Virginia, 28-30 October 1991.

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13. Interview between Mr. Wayne Abba, Program Analyst, Office of the Under Secretary of Defense (Acquisition), and the author, 21 August 1991.

14. Interview between Mr. Harold W. Nelson, Project Manager, Ebasco Services, and the the author, 18 August 1991.

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