

IG-99-058

**AUDIT
REPORT**

EARNED VALUE MANAGEMENT AT NASA

September 30, 1999



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Space Administration

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Acronyms

CFO	Chief Financial Officer
DCMC	Defense Contract Management Command
DoD	Department of Defense
EVM	Earned Value Management
FAR	Federal Acquisition Regulation
NPD	NASA Program Directive
NPG	NASA Procedures and Guidelines
OIG	Office of Inspector General
PMC	Program Management Council
RDT&E	Research, Development, Test, and Evaluation
SMO	Systems Management Office

W

September 30, 1999

TO: AE/Chief Engineer
B/Chief Financial Officer

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Audit Report on Earned Value Management at NASA
Assignment Number A9905500
Report Number IG-99-058

The subject final report is provided for your use and comments. Although management's comments were due by September 20, 1999, comments were not received as of the date of this report. Therefore, please provide your response to the final report not later than November 1, 1999. Please refer to the finding paragraph for the overall audit results. All recommendations remain open for reporting purposes until corrective actions are completed. In addition to providing your comments on the report, please notify us when action has been completed on the recommendations, including the extent of testing performed to ensure corrective action are effective.

If you have questions concerning the report, please contact Mr. Lorne A. Dear, Program Director, Procurement Audits, at (818) 354-3360; Mr. Tony A. Lawson, Audit Program Manager, at (301) 286-6524; or Ms. Sandra L. Laccheo, Auditor-in-Charge, at (757) 864-3458. We appreciate the courtesies extended to the audit staff. The final report distribution is in Appendix D.

[original signed by]

Russell A. Rau

Enclosure

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NASA Office of Inspector General

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Earned Value Management at NASA

Introduction

Earned value is a method for project managers to objectively measure the amount of work accomplished on a contract. Earned value provides project managers valid, timely, auditable contract performance information on which to base management decisions. Earned value management (EVM) (1) integrates cost, schedule, and technical scope of work; (2) allows for continuous measurement of integrated performance throughout the contract; and (3) provides project managers a means to better estimate total contract costs and the total duration of contracts. Our overall audit objective was to evaluate how effectively NASA managers are using earned value in managing contracts. Appendix A contains details on our objectives, scope, and methodology.

Background

In February 1997, the Agency issued NASA Policy Directive (NPD) 9501.3, "Earned Value Performance Measurement," to establish the basis for applying EVM to NASA contracts. Before issuance of the directive, NASA Centers used their individual policies on performance measurement systems. NPD 9501.3 requires NASA project managers to ensure implementation of criteria-based EVM¹ on all significant contracts. Significant contracts are cost-reimbursement-type contracts that are:

- research, development, test, and evaluation (RDT&E)² contracts with an estimated final value of \$60 million or more and a period of performance greater than 1 year and
- production contracts with an estimated final value of \$250 million or more.

¹ EVM system criteria define the attributes that management control systems must possess to effectively capture and present earned value data. There are 32 EVM system criteria. Each criterion addresses a major principle necessary for effective contract management. The criteria are organized into five categories: (1) organization, (2) planning and budgeting, (3) accounting, (4) analysis, and (5) revisions.

² NASA is substituting the word "development" for "research, development, test, and evaluation" in the subsequent version of NPD 9501.3.

Project managers must use noncriteria-based EVM³ on certain contracts, unless waived by the NASA Center Chief Financial Officer (CFO). Contracts requiring noncriteria-based EVM are:

- RDT&E contracts with an estimated total value of \$25 million but less than \$60 million and
- production contracts of less than \$250 million.

During the audit, we issued a report on the need for an integrated baseline review and on the need to revise draft NASA EVM policy. See Appendix B for a summary of the prior report.

Use of and Reliance on EVM Information

Finding. The Agency has made progress toward establishing a structure for EVM application on contracts. For example, NASA created the EVM Focal Point Council to provide a consistent approach for implementing EVM throughout NASA, established Agency-wide provisions and clauses for use in solicitations and contracts when EVM is required, and improved communications on EVM with other Government agencies and industry. Further, NASA is developing a Memorandum of Understanding to clarify the Defense Contract Management Command (DCMC) responsibilities for EVM surveillance. Each area is discussed in Appendix C.

However, to effectively use EVM as a management tool, it must be an integrated part of program and project management. To accomplish this, the Agency can make some improvements. EVM policy is not consolidated as an overall program and project management responsibility, and managers do not provide comprehensive EVM information to the Program Management Council (PMC).⁴ EVM policy is in both a financial management directive and a program and project management guide. The fragmentation of the policy results in the unnecessary separation of authority for EVM policy, which has been delegated to the CFO, while the day-to-day responsibility for EVM implementation rests with the program and project managers. EVM is not solely a financial tool. In fact, its greatest contribution is to the effective management of NASA programs and projects. Therefore, the authority to implement policy should be aligned with the responsibility for program and project management rather than with the fiscal chain of command and fiscal policy directives. In this manner, EVM can be fostered through other than the encouragement of the NASA CFO.

Fragmented EVM Policy. In 1989, the Department of Defense (DoD) began the cultural shift from viewing EVM as a mandatory financial reporting requirement to a valuable and

³ Noncriteria EVM allows the contractor greater flexibility in the selection of internal performance measurement techniques. Contractors are not required to establish, maintain, or use a management control system that meets EVM criteria. The purpose of noncriteria EVM is to provide for better management control of small programs and projects.

⁴ The PMC is the senior management group that is chaired by the NASA Deputy Administrator and is responsible for recommending approval for and overseeing implementation of proposed programs according to Agency commitments, priorities, and policies. Other PMC's have been established at the NASA Center level.

fundamental project management tool. DoD transferred the EVM policy organization from the Comptroller's Office to acquisition management. This change marked the beginning of a major shift in "ownership" of EVM from finance to project management. NASA has aligned its EVM processes to parallel DoD's policy. However, the Agency issued EVM policy in a financial management directive, NPD 9501.3.⁵

NPD 9501.3 establishes the requirement to apply EVM to NASA contracts. The directive states that the Chairperson of the NASA PMC is the policy official ultimately responsible for the implementation of EVM on significant contracts within NASA. However, the PMC Chairperson delegated to the CFO the authority to implement NPD 9501.3.⁶ Accordingly, the CFO is responsible for measuring and reporting EVM compliance and has the authority to grant waivers for contractor systems that do not meet EVM criteria.

EVM policy is also addressed in NASA Procedures and Guidelines (NPG) 7120.5A, "NASA Program and Project Management Processes and Requirements." The NPG establishes the requirements for the formulation, approval, implementation, and evaluation of all Agency programs and projects. The policy requires program and project managers to ensure that all management system requirements are appropriately implemented. Chapter 4 of the NPG contains the management system requirements,⁷ including EVM. The Office of Chief Engineer is responsible for the maintenance of NPG 7120.5A.

To help ensure compliance with NPG 7120.5A, NASA is creating a Systems Management Office (SMO) at each Center that will:

- report to the Center Director,
- review and evaluate Center programs and projects, and
- provide independent evaluations on how well programs and projects are meeting their cost and schedule commitments.

EVM Emphasized as a Financial Reporting Tool. Before the Agency issued NPD 9501.3, NASA Centers used their individual policies on performance measurement systems. The Center CFO's had primary responsibility for conducting compliance reviews of contractors' performance measurement systems. Management considered these compliance reviews a financial evaluation. Although project managers are now responsible for ensuring EVM implementation on all required contracts, managers continue to view EVM as a financial

⁵ Appendix C of NPG 1400, "NASA Directives System Procedures and Guidelines," lists subject-classification numbers for NASA directives. The number assigned to a directive is based on its subject matter. Numbers 7000 through 7999 are assigned to program formulation policy, and numbers 9000 through 9799 are assigned to financial management.

⁶ The delegation to the CFO is specified in NPD 9501.3.

⁷ The management system requirements are resources management, risk management, performance measurement, acquisition management, and safety and mission success and environmental management.

reporting tool rather than as a project management tool. Viewing EVM as a financial management tool adversely affects the manner in which EVM analysis is conducted and the way results are used in project management. When the SMO's are functional, managers will likely continue to view EVM as a financial requirement because primary EVM policy is in a financial management directive.

EVM is more than a financial tool. EVM provides insight into the status of the program or project and helps forecast future cost performance based on present trends. The capability to trace problems to their source facilitates early visibility of unfavorable cost and schedule trends, which can be corrected before they become material. Favorable variances can be an indication of poor initial planning, technical breakthroughs, or front-end loading.⁸ Project managers may already be aware of problems causing significant variances through other formal or informal reporting systems. However, EVM information quantifies the cost impact of the problems, and that information would be difficult to ascertain otherwise. Further, project managers can correlate the EVM system schedule variances with the outputs of the formal scheduling system, thus permitting a cross-check on the validity of work performed and associated variances.

Minimal EVM Information Reported to PMC's. The project managers' briefings to the Center PMC's did not contain comprehensive EVM information. The briefings generally included only minimal EVM information; however, they included the financial status on projects, such as comparisons of planned and actual obligations, funding received, and uncosted obligations.⁹ Program and project managers report financial-related information because they also support the annual Program Operating Plan¹⁰ by providing assessments of affordability for NASA funding requirements. The assessments of affordability enable a firm commitment to accomplish program and project goals and objectives on schedule and within budget.

The PMC's serve as high-visibility forums for raising issues related to specific programs and projects. The PMC's are responsible for assessing existing programs and projects and for evaluating cost, schedule, and technical content to ensure that the Agency meets its commitments specified in the Program Commitment Agreement, Program Plan, and Project Plan.¹¹ Further, PMC's recommend continuation or cancellation of programs and projects.

⁸ Front-end loading is deliberate over budgeting early in the life of the program to create a more favorable cost variance early in the program.

⁹ Obligations are amounts of orders placed, contracts awarded, or services received for bona fide needs that will require payments that comply with applicable laws and regulations. For contracts, uncosted obligations occur when an amount is not accrued (costed) because goods are not received or monthly services are not performed.

¹⁰ NASA Centers produce the Program Operating Plan in response to Headquarters-directed budget guidelines. It is a compilation of requested budgets by program or project.

¹¹ The Program Commitment Agreement is an agreement that documents the Agency's commitment to execute program requirements within established constraints. Additional commitments are documented in the Program and Project Plans, which detail the approach and plans for formulating, approving, implementing, and evaluating programs and projects.

Need for Comprehensive EVM Reporting. While we recognize the importance of budget information, EVM information is equally important. Earned value provides a more accurate picture of project status than budget or actual cost information alone, because earned value provides the budgeted cost of the work actually accomplished. The EVM “early warning” system provides reliable and timely identification of trends requiring corrective action and gives managers the ability to predict cost overruns and schedule slips.

When EVM is applied, NASA managers receive contractor cost performance reports that identify the magnitude and impact of actual and potential problem areas causing significant cost and schedule variances. NASA managers should use the contractor-provided data to provide project status information to the Center PMC’s. Reporting should include information on the current project status such as the cost and schedule performance indexes,¹² an evaluation of the contractor’s use of management reserve¹³ and recovery plans for schedule slips or cost variances, and forecasts of the contract estimate at completion. More comprehensive EVM reporting to the PMC’s will establish the need for and demonstrate senior management commitment to EVM. The PMC’s will also be in a better position to determine whether NASA projects should be continued or cancelled.

In the near future, we will issue a report on the International Space Station that will recommend greater emphasis on EVM reporting.

Need for Policy Change. The CFO is not responsible for overseeing project management processes and, therefore, is not in the best position to implement EVM policy, to measure and report compliance with such policy, or to be the decisionmaker on waivers of compliance with contractor EVM systems. To increase visibility as a project management tool, EVM policy should be embodied in the program and project management directives and guidance. The Associate Administrators or Center Directors, not the CFO, should be prescribing use of EVM for program and project management for two reasons:

- the Associate Administrators are responsible for leadership and management and are the focal points for accountability and
- Agency programs are assigned to NASA Centers, which are responsible for implementation and accountability for meeting schedule and budget guidelines.

¹² The cost performance index is the ratio of budgeted costs of work performed to actual costs and is often used to predict the magnitude of a possible cost overrun. The schedule performance index is the ratio of work performed to work scheduled. The indexes provide an indication of the cost and schedule efficiency with which work has been accomplished. An index of 1.0 indicates that cost is on target or that the contractor is performing on schedule.

¹³ Management reserve is an amount of total allocated budget withheld for management control purposes rather than designated for the accomplishment of a specific task. Management reserves are intended to reduce the risk of missing cost or schedule objectives. Use of management reserve requires a change to the performance measurement baseline.

Therefore, consolidating EVM policy in program and project management would emphasize the significance of EVM as a project management tool and would result in more effective EVM execution on required contracts.

Recommendations for Corrective Action

The Chief Engineer should:

- 1. Coordinate with the CFO and issue EVM policy as program and project management directives and guidance.**
- 2. Establish procedures for program and project managers to report comprehensive EVM information in PMC status briefings.**
- 3. The PMC Chairperson should delegate the authority to implement and to measure compliance with EVM policy to the Associate Administrators or Center Directors.**

Management's Response

Management did not provide comments on the draft report. Therefore, management should provide complete comments on the final report.

Appendix A. Objectives, Scope, and Methodology

Objectives

The overall audit objective was to evaluate how effectively NASA managers are using earned value to manage NASA contracts. Specifically, we determined whether:

- EVM was effectively implemented on contracts and
- NASA managers effectively used the DCMC for EVM system surveillance.

Scope and Methodology

To determine whether EVM was effectively implemented on contracts, we:

- interviewed project teams and NASA officials at Goddard Space Flight Center (Goddard), Johnson Space Center (Johnson), and Marshall Space Flight Center (Marshall);
- attended a NASA-sponsored EVM workshop in Huntsville, Alabama, in September 1998;
- reviewed NASA and DoD regulations and DoD presentations and related documents;
- evaluated cost performance reports and reviewed contractual documents;
- discussed EVM implementation procedures with EVM focal points;
- evaluated the draft and final NASA Federal Acquisition Regulation (FAR) Supplement provisions and clauses published in the “Federal Register”; and
- reviewed briefing packages presented to the PMC’s.

To determine whether NASA managers were effectively using DCMC, we reviewed contract letters of delegation for the applicable FAR subparts.¹⁴ We reviewed surveillance plans and reports on two contracts where EVM surveillance was specifically delegated to DCMC. No other contracts reviewed had specific EVM surveillance delegations. We discussed the type of support the project offices were receiving from DCMC. We also attended the meeting with DCMC to prepare a draft Memorandum of Understanding to clarify the responsibilities with regard to EVM surveillance.

We relied on computer-processed data from the Program Operations Division, Office of Procurement, to determine the audit sample selection. Although we did not perform a formal reliability assessment of the computer-processed data, we determined that the contract numbers, award dates, and contractor names agreed with information maintained in NASA’s on-line query system, Financial and Contractual Status. We also compared data in the NASA Headquarters electronic listing to data provided by the EVM focal points.

¹⁴ The FAR contains a list of contract administration functions. Subparts 42.302(a)(15)(40)(41) and (67) are related to EVM.

Appendix A

Contracts Reviewed

NASA issued Agency-wide EVM policy in February 1997. At the time of our audit, NASA had awarded only three contracts since February 1997 that were greater than \$60 million.¹⁵ Therefore, we selected contracts awarded before February 1997 because each NASA Center had individual policy on performance measurement systems.

We judgmentally selected 17 contracts shown in Table A-1 from an electronic list of active contracts as of August 31, 1998. The Program Operations Division, Office of Procurement, provided the list. We selected contracts:

- that were classified as research and development on the electronic list,¹⁶
- for which EVM had been implemented,¹⁷ and
- for which EVM had not been implemented.¹⁸

We judgmentally selected six planned acquisitions shown in Table A-2 from an electronic copy of NASA's Master Buy Plan¹⁹ as of November 17, 1998. The Program Operations Division, Office of Procurement, provided the list. We eliminated projects for services, support, construction, and change orders for existing contracts. We also eliminated projects with anticipated values less than \$60 million.

We concentrated our efforts on contracts awarded by or planned acquisitions at Goddard, Johnson, and Marshall because the three Centers had awarded the most significant percentage of contract dollars.

¹⁵ Criteria-based EVM is required on RDT&E contracts with an estimated final value of \$60 million or more and a period of performance greater than 1 year.

¹⁶ NASA policy states that EVM should be used on RDT&E and production contracts; however, NASA does not officially classify its contracts as RDT&E and production. NASA classifies contracts as supplies and equipment, services, or research and development. The classifications are from the Federal Procurement Data System, Product and Service Codes.

¹⁷ We obtained from the EVM focal points the list of contracts that had implemented EVM. The EVM focal points identified 37 contracts that had applied criteria-based and noncriteria-based EVM.

¹⁸ The contracts had remaining funds of \$60 million or more and at least 2 years remaining before contract completion.

¹⁹ The Master Buy Plan provides information on planned acquisitions to enable management to focus its attention on a representative selection of high-dollar-value and sensitive acquisitions.

Table A-1. Selected Contracts

Contract	Contractor	Award Date	Estimated Value (in thousands)
NASW 4300 ¹	Grumman Aerospace Corporation	07/31/87	\$1,219,367
NAS5 32000 ¹	Lockheed Martin Corporation	12/23/87	921,089
NAS5 32500 ²	Lockheed Martin Corporation	08/13/90	680,947
NAS5 32954	TRW, Inc.	09/15/95	381,889
NAS5 60000	Hughes Information Tech. Corp. (Raytheon)	03/30/93	868,638
NAS5 98009 ³	New Mexico State University, Las Cruces	02/17/98	66,875
NAS8 36200 ²	Lockheed Martin Corporation	06/07/88	3,642,798
NAS8 38100	Thiokol Corporation	07/17/91	3,950,958
NAS8 45000	Boeing North American, Inc.	06/28/96	1,473,258
NAS9 18000 ¹	Boeing North American, Inc.	01/01/86	5,340,321
NAS9 18181	Hughes Training, Inc. (Raytheon)	10/15/89	684,903
NAS9 18200 ¹	McDonnell Douglas	12/23/87	4,624,066
NAS9 18300	Lockheed Martin Corporation	01/17/90	698,127
NAS9 18800 ⁴	Johnson Engineering	04/29/93	317,995
NAS9 97005 ⁵	Wyle Laboratories	02/01/97	56,761
NAS9 97150 ⁵	Hamilton Standard Space Systems	09/25/97	125,881
NAS9 97220 ⁶	Canadian Commercial Company	12/31/97	64,699

¹ EVM was not implemented on the contract. We eliminated the contract from our review because the contract was terminated, cancelled, or incorporated into the Space Flight Operations Contract. The Space Flight Operations Contract is for Space Shuttle operations.

² We selected the contract because it was featured on a DoD acquisition reform satellite broadcast in November 1997. The broadcast addressed DoD's initiative on EVM.

³ The contract is for balloon services and did not meet the requirement for EVM.

⁴ EVM was not implemented on the contract.

⁵ The contract did not meet the requirement for criteria-based EVM.

⁶ The contract is an indefinite order/indefinite delivery contract. The award was to a Canadian company and is administered by the Canadian government. EVM was not implemented.

Appendix A

Table A-2. Selected Planned Acquisitions

Project Description	Lead Center	Estimated Value (in millions)
Next Generation Space Telescope Phased Development ¹	Goddard	\$ 700
Rapid Spacecraft Acquisition II ²	Goddard	1,500
Medium-Class Explorer Missions	Goddard	175
Flight Hardware Development and Sustaining Engineering ³	Johnson	160
Reusable Solid Rocket Motors, Buy No. 4 ⁴	Marshall	2,000
External Tank, Buy 6, Phase 111, Long-Lead Hardware ⁴	Marshall	681

¹ The contract will not be awarded until approximately 2003. Plans are to implement EVM when the contract is awarded.

² A firm-fixed-price contract will be awarded. EVM is not required on firm-fixed-price contracts.

³ The project was cancelled.

⁴ The contract will be included as a subcontract under the Space Operations Flight Contract.

Audit Field Work

We performed audit field work from August 1998 to July 1999 at NASA Headquarters, Goddard, Johnson, and Marshall. We performed the audit in accordance with generally accepted government auditing standards.

Appendix B. Prior Office of Inspector General Review

Audit Report Number IG-99-037, “Earned Value Management at NASA — ECS Performance Measurement Baseline,” September 10, 1999. The report discusses the need to perform an integrated baseline review after the negotiation of a major contract modification. The report recommended revising draft NPG 9501.4, “Earned Value Management Implementation on NASA Contracts,” and issuing the document as soon as practical. The revision should include the requirement to perform the baseline review after contract award, the exercise of contract options, or incorporation of major contract modifications. Management agreed to conduct the baseline review. Management stated it would issue NPG 9501.4 as soon as practical and would consider the recommendation to modify the guide. These issues have not yet been resolved.

Appendix C. Positive Actions to Establish EVM Framework

NASA has taken actions to establish the infrastructure for EVM implementation. NASA created the EVM Focal Point Council, modified the NASA FAR Supplement to include EVM provisions and clauses for use in solicitations and contracts, and improved communications on EVM with other Government agencies and industry. Further, NASA is developing a Memorandum of Understanding to clarify the DCMC responsibilities for EVM surveillance. Each area is discussed below:

EVM Focal Point Council

NASA created the EVM Focal Point Council in December 1996. The council, chaired by the Lead Center EVM Focal Point at Marshall, is responsible for developing implementation procedures and for addressing EVM implementation reviews and surveillance issues and activities. Members include a representative from each NASA Center, the Office of Procurement, and the Office of the CFO. Focal point responsibilities are defined in draft NPG 9501.4, "Earned Value Management Implementation on NASA Contracts." Each council member ensures consistent EVM implementation on applicable NASA contracts, develops and provides EVM training, assists the contracting officer and project manager in developing EVM contractual requirements, and serves as consultant to source evaluation boards in evaluating contractor proposals. In addition, the EVM Focal Point Council provides an open forum for the Center EVM focal points to share their experiences and to develop a network of support within the NASA EVM community.

NASA-Wide EVM Clauses Established

When NPD 9501.3 was issued in February 1997, NASA had no EVM provisions or clauses for use in Agency solicitations and contracts. In March 1999, the Agency modified the NASA FAR Supplement by establishing Agency-wide provisions and clauses, similar to those used by the DoD, for use in solicitations and contracts that require EVM. NASA and DoD are major customers in the aerospace industry. As such, they collaborated to align their approaches to the use of EVM. The change to the NASA FAR Supplement clarified the role of the DCMC with respect to its responsibility for EVM surveillance.

Improved Communication with Other Government Agencies and Industry

The EVM Focal Point Council has worked to establish effective communications with other Government agencies through participation in the DCMC Program Management Advisory Council as well as representing NASA at industry EVM forums sponsored by the National Defense Industrial Association and other professional organizations. The participation has

provided greater consistency in EVM implementation throughout the Government and has encouraged greater partnering with industry. The participation has also provided those outside the Agency a single focal point for coordinating EVM issues within NASA.

EVM Surveillance

NASA either retains or delegates to the DCMC surveillance of EVM. Surveillance begins with the award of the contract, continues through EVM system evaluation and acceptance, and extends throughout the duration of the contract. Surveillance ensures the Government project manager that the contract data produced by the EVM system is reliable and accurate for decisionmaking. Periodic assessments verify that the contractor's EVM system continues to meet contractual requirements and generates timely and valid performance data for Government and contractor use.

The DCMC is responsible for ensuring the effective implementation of EVM within DoD and for ensuring the integrity and effectiveness of EVM process applications. In March 1999, the Agency changed the NASA FAR Supplement to clarify the role of DCMC with respect to its responsibility for reviewing EVM system descriptions (descriptions of internal management control systems) and for verifying initial and continuing contract compliance with NASA and DoD EVM system criteria. The new NASA FAR Supplement provisions and clauses created a need to clarify for NASA managers how DCMC will perform EVM surveillance for NASA contracts.

The EVM Focal Point Council, with DCMC participation, drafted a Memorandum of Understanding that describes the services DCMC will provide for NASA. The intent of the memorandum is to streamline the EVM delegation process and to ensure a minimum acceptable level of support under the delegation. After approval of the memorandum, the project office will reference it in the letter of delegation of EVM surveillance to DCMC. If the project manager requests additional surveillance support, the letter of delegation will specify the required assistance.

Appendix D. Report Distribution

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