OFFICE OF THE UNDER SECRETARY OF DEFENSE

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ACQUISITION AND TECHNOLOGY

Mr. David E. Cooper
Director, Acquisition Policy, Technology
and Competitive Issues
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Cooper:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) report, "TEST AND EVALUATION: DoD Slow in Improving Testing of Software-Intensive Systems," dated September 28, 1993, (GAO/NSAID-93-198). As noted in the DoD response to the draft of this report (provided in Appendix III) the DoD partially concurs with the report and concurs with the recommendations.

Additional detailed DoD comments on the report recommendations are provided in the enclosure. The DoD notes the changes made to the report after our comments were provided on the draft report and appreciated the opportunity to comment.

Sincerely,

Charles E. Adolph
Director
Test and Evaluation

Enclosures

cc:
USAF SAE
USN SAE
USA SAE
DLA SAE
→DISA
ASD C3I
USD(A)PI
DOT&E

GAO FINAL REPORT GAO/NSIAD-93-198--DATED SEPTEMBER 29,1993
(GAO CODE 396241) OSD CASE 9439

"TEST AND EVALUATION: DoD Has Been Slow in Improving Testing of Software-Intensive Systems"

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GAO Rebuttal Comments

Rebuttal Issue 1: The pervasiveness and significance of software problems in critical defense systems clearly warrant special attention.

DoD Position: While generally concurring with the GAO position on this issue, The DoD maintained that the GAO did not recognize or acknowledge measures taken by the DoD to identify immature software-intensive systems prior to operational test and evaluation. The DoD pointed out that most of the programs reviewed by the GAO were governed by previous DoD guidance. The DoD cited the revised DoD 5000 series directives and instructions and the revised procedures for review and approval of Automated Information Systems 8120 series as the means of managing the problems identified by the GAO.

GAO Rebuttal: The GAO asserted that the issuance of revised DoD procedures without incentives to change behavior or ensure effective implementation has had little effect in ensuring software maturity. The GAO contended that the pervasiveness and significance of software problems in critical defense systems clearly warrant special attention, as reflected in the GAO recommendations. In addition, the GAO asserted that the revised acquisition policy series has some voids and, more importantly, it remains to be seen whether and to what degree the policy updates will be implemented and whether they will actually address longstanding problems.

Additional DoD Comments: The DoD concurs that the mere issuance of policy without follow-up does not ensure compliance. The DoD Task Force on Improving Software Test and Evaluation completed their efforts on November 1, 1993, and their final reports are attached. The recommendations include and expand on GAO recommendations. The U.S. Army has agreed to provide expert personnel to assist the Director, Test and Evaluation in negotiations with the other offices of the DoD to implement the Task Force recommendations. The implementation time frame is within the time frame of the GAO recommendations.

Rebuttal Issue 2: Potential Savings of a Common Software Metrics Tool Will Become More Evident

DoD Position: The DoD pointed out that software metrics addressing cost and schedule are not test and evaluation tools.

The GAO provided no supporting evidence that metrics would support test and evaluation. (p. 53/GAO final report)

GAO Rebuttal: The GAO pointed out it did not attempt to quantify the direct benefits of software metrics for operational test and evaluation. The GAO asserted, however, that experts in both the DoD and the private sector have indicated that software metrics could improve the management of the development process and, thus, contribute to greater software maturity before beginning operational test and evaluation. The GAO concluded that, as the common policies, procedures, and management tools are developed within DoD, the potential savings of a common software metrics tool will become more evident. (pp. 35-36/GAO final report)

Additional DoD Comments: The DoD Task Force on Improving Software T&E (noted in the DoD additional comments to Rebuttal Issue 1) has recommended the DoD adopt the Army's Software Test and Evaluation Program metrics as the basic DoD metrics.

CURRENT STATUS OF AGREED TO ACTIONS IN RESPONSE TO GAO RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommended that the Secretary of Defense issue and implement a software test and evaluation policy that defines testing requirements for software maturity, regression testing, and the use of temporary software fixes during testing. (pp. 6,34/GAO final report)

DoD Response: Concur. This and the other GAO recommendations are contained in the recommendations of the DoD Task Force on Improving Software Test and Evaluation Final Report. DoD expects definitive policy to be completed and issued by the Office of the Under Secretary of Defense for Acquisition during the second quarter of FY 1994.

RECOMMENDATION 2: The GAO recommended that the Secretary of Defense strengthen controls to ensure that operational testing does not begin until results of developmental test and evaluation demonstrate an appropriate level of software maturity. (pp. 6,34/GAO final report)

DoD Response: Concur. The Director, Operational Test and Evaluation will issue such policy as necessary to strengthen software maturity testing controls for entry into operational test. This policy will be issued during the second quarter of FY 1994.

RECOMMENDATION 3: The GAO recommended that the Secretary of Defense require program management officials to define exit criteria for certifying a system's readiness for operational testing at the beginning of full-scale development. (pp. 6,34/GAO final report.

DoD Response: Concur. The Office of the Under Secretary of Defense will issue policy during the second quarter of 1994. Such policy will require the program management officials to define exit criteria at Milestone II for certifying system readiness for dedicated operational testing.

RECOMMENDATION 4: The GAO recommended that the Secretary of Defense require the Services to develop a common core set of management metrics for software (i.e., cost, schedule, and quality) for major defense programs early in the development cycle to be approved at Milestone II. (pp. 6,34/GAO final report)

DoD Response: Concur. The recommended metrics are not software test and evaluation issues. However, the DoD recognizes these management metrics are essential for effective system development. Accordingly, the Under Secretary of Defense for Acquisition will require the Services to develop the necessary metrics prior to entry into the Engineering Manufacturing Development Milestone II phase of acquisition.

PROPOSED IMPLEMENTATION ACTION ITEMS

TO

IMPROVE DoD ACQUISITION OF SOFTWARE

PREMINARY RESULTS

FROM

THE TASK FORCE ON IMPROVING SOFTWARE TEST AND EVALUATION

November 1993

Chairman: Dr. H. Steven Kimmel
Deputy Director
Test and Evaluation
Office of the Under Secretary of Defense (Acquisition)

INTRODUCTION

Three Working Groups were assembled from among Department elements and organized as follows:

Policy	Chaired by	Lt Col Larry Damman, USAF Chairman, Test and Evaluation Department Defense Systems Management College
Procedures	Chaired by	Dr. John Foulkes Deputy Director U.S. Army Test and Evaluation Management Agency Department of the Army
Tools	Chaired by	Mr. George Hurlburt Secretariat Test and Evaluation Community Network Naval Air Weapons Center Aircraft Division

The preliminary* results of their 1993 deliberations are presented in the ensuing three tables.

*Note

The term preliminary is used as the findings are uncoordinated at present. Each working group chairman is in the process of finalizing a more detailed report.

Table 1
Software Policy Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
P-1 There is no appropriate defined process for documenting user requirements (and change/evolution) of software intensive systems. In addition, current processes used by DoD to define functional requirements for software are error prone, e.g. they do not address the evolutionary acquisition environment of software intensive systems.	Provide a coherent and consistent policy which addresses the iterative/evolutionary nature of requirements generation for software intensive systems and encourages the evaluation and implementation of new technologies that support these efforts.	USD(A&T) in coordination with ASD(C3I)
P-2 Policy for acquisition, Life Cycle Management (LCM) and interoperability of software intensive systems is defined in at least three distinct DoD documents. This has contributed to confusion due to different terminology and processes being applied to similar system development efforts.	Designate a single focal point in DoD for acquisition, LCM and interoperability of software intensive systems. Consolidate/integrate the DoD 4630/5000/8120 series documentation. Create common definitions and criteria for software intensive systems. Clarify roles and responsibilities of software T&E organizations.	USD(A&T) in coordination with ASD(C3I)
P-3 Test and Evaluation on software intensive systems is seen as a separate distinct final exam of system capability at the end of the acquisition/development effort.	Define policy that makes test and evaluation a value-added, risk reduction process which is the result of a combined cooperative team effort and requires a concurrent engineering approach for software intensive acquisitions that includes all functional disciplines throughout the life cycle.	USD(A&T) in coordination with ASD(C3I)

Table 1 (Cont'd)
Software Policy Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
P-4 Defect prevention on software intensive systems is not generally funded or scheduled early in the acquisition process and is not encouraged by the present policy. This leads to increased risk and significant increases in resources required for later test and evaluation efforts.	Define policy that requires the early application of resources for defect prevention techniques and that requires the use of appropriate processes and tools for defect prevention. Develop a process to ensure that the resource management and allocation community recognize the advantage of adequate funding early in the program.	USD(A&T) in coordination with ASD(C3I)
P-5 Configuration management on software intensive systems is conducted in an incomplete, haphazard and inconsistent manner.	Provide, as part of the new merged policy, a process which directs implementation of continuous and integrated system level configuration management throughout the life cycle of software intensive systems.	USD(A&T) in coordination with ASD(C3I)
P-6 The DoD lacks clear and concise policy defining the requirement for OT&E on evolutionary and incremental development of software intensive systems.	Develop a logical process which provides for the identification of criteria regarding the frequency and intensity of OT&E(s) on evolutionary/incremental acquisitions and develop policy which implements this process.	USD(A&T) in coordination with ASD(C3I), DOT&E and all five of the OTAs
P-7 The DoD lacks clear and concise policy defining the requirement for OT&E on NDI/COTS/Reuse software intensive systems.	Identify criteria regarding the frequency and intensity of OT&E(s) on NDI/COTS/Reuse software intensive systems and develop policy which implements this process to recognize that each NDI/COTS/Reuse software intensive program is unique.	USD(A&T) in coordination with ASD(C3I), DOT&E and all five of the OTAs

Table 1 (Cont'd)
Software Policy Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
P-8 The DoD Acquisition Workforce lacks a defined and supported process to gain the appropriate skills needed to successfully execute the acquisition and life-cycle management, and ensure the interoperability of software intensive systems. This results in high risk software intensive systems.	Develop policy that will result in the education of, and improvement in the performance of, the entire acquisition workforce, including management of software development and T&E as an element and to establish a software career path in the DoD Acquisition Workforce.	USD(A&T) in coordination with ASD(C3I)

Table 2
Software Procedures Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
PR-1 Development of DoD software is costly and slow.	Develop software development procedures that provide for exploiting automated tools that help define requirements, help design and document the system, generate code, help with configuration management, and make maintenance easier by developing embedded test instrumentation.	OUSD(A) advocacy, Services execution.
PR-2 Policy for the acquisition of software intensive systems is defined in at least three distinct DOD documents.	Provide and implement a single source of policy for software intensive systems acquisition, which includes: • development of a user functional description (UFD) or ORD • user involvement throughout the software development process • incremental blocks of development and testing • a decision mechanism which authorizes fielding of the block(s) • a decision point for certification of an operationally tested representative sample.	OUSD(A) advocacy, Services execution.
PR-3 There is no appropriately defined process for documenting user requirements of software intensive systems.	Implement a coherent and consistent policy for software intensive systems which uses an Integrated Product Development (IPD) Team approach, including the use of rapid prototyping tools. The end product of the requirements definition process should be an IPD Team consensus UFD which articulates the user's requirements and guides both the system design and test planning working group processes.	OUSD(A) advocacy, Services execution.

Table 2 (Cont'd)
Software Procedures Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
PR-4 Defect prevention on software intensive systems is not an activity generally resourced early in the acquisition process. This leads to increased risk and significant increases in resources required for later test and evaluation efforts.	Implement the early application of defect prevention techniques, implementing the "Fagan" inspection as a means of reducing errors. Less formal in-process product evaluations, consisting of peer reviews and design and code walk-throughs can be used where formal inspections may be too restrictive.	OUSD(A) advocacy, Services execution.
PR-5 Test and Evaluation of software intensive systems is seen as a separate and distinct final exam of system capability at the end of the acquisition effort.	Implement T&E policy that reflects the incremental nature of software development. Decision reviews can be used to mark the approval of the design of the first block and authorize both the completion of this block and the start of the development of subsequent blocks as resources become available. These actions will culminate in the fielding of the system.	OUSD(A) advocacy, Services execution.
PR-6 The DoD lacks clear and concise policy defining the requirements for OT&E on evolutionary, incremental, NDI, COTS, and reuse software intensive systems.	Implement a process that utilizes a Combined Test Force (CTF) consisting of the developer or contractor, the government DT&E agency, and the government OT&E agency to coordinate testing efforts and eliminate duplication. OT&E should be conducted concurrently with DT&E and should emphasize operator familiarization, early operational assessments, and preliminary OT&E. The CTF will make a recommendation, and the program manager will certify the system ready for OT&E prior to commencing final OT&E.	OUSD(A) advocacy, Services execution.

Table 2 (Cont'd)
Software Procedures Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
PR-7 Configuration management on software intensive systems is conducted in a haphazard and inconsistent manner.	Implement a process which directs implementation of continuous and integrated system level configuration management throughout the life cycle of software intensive systems. The configuration management function will support the initial test and evaluation efforts by assigning unique identifiers to and controlling the approved versions of all initial planning documents. Each approved increment of the system defined in the UFD should be managed by a configuration control board.	OUSD(A) advocacy, Services execution.
PR-8 Post-deployment software support requires formal processing and is sometimes disruptive to the deployed system.	Develop post-deployment software support procedures which minimize required formal processing and avoid disruption in the deployed system.	OUSD(A) advocacy, Services execution.

Table 3
Tools Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
T-1 There is need for a high level individual in the DoD with the responsibility to promote and coordinate the use of modern software development methodologies and tools.	Designate a visionary individual in the Office of the Under Secretary of Defense for Acquisition OUSD(A) to advocate and coordinate the top-down management vision of DoD software development, based on modern tools and methodologies.	Under Secretary of Defense for Acquisition USD(A)
T-2 Software T&E tends to occur late in the acquisition process when errors are costly to correct.	Establish policy that enforces early and continuous involvement by T&E personnel, based on available software tools.	OUSD(A) advocacy, Services execution.
T-3 The software tools and methodologies require the kind of profound knowledge borne from research.	Institute and provide 6.0 - 6.3A funding for research programs that focus on advanced concepts in technology maturation for software tools and methodologies for a formal technology transition.	OUSD(A) advocacy, ARPA execution.
T-4 Software T&E is not well integrated with software design and development.	Establish procedures that make T&E an integral part of the software design and development cycle to allow for more effective utilization of modern software tools in software T&E.	OUSD(A) advocacy, Services execution.
T-5 Integration of software T&E with design and development is a long term endeavor.	Establish software development policies that will eventually mesh T&E into the entire software life cycle in order to harness the value of modern tools.	OUSD(A) advocacy, Services execution.
T-6 DoD software T&E personnel are subject to career uncertainty.	Establish software development procedures that create a tool-based environment where the software T&E professional's role is clearly defined.	OUSD(A) advocacy, Services execution.

Table 3 (Cont'd)
Tools Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
T-7 DoD software requirements are not effectively managed.	Establish procedures for managing traceable software requirements for testability using appropriate tools.	OUSD(A) advocacy, Services execution.
T-8 The T&E community does not become involved in understanding requirements until firm specifications exist.	Establish software requirements analysis procedures that adapt evolving tool-based methodologies that include T&E participation.	OUSD(A) advocacy, Services execution.
T-9 Software tools are not yet fully in the T&E professional's repertoire.	Establish policy aimed at creating a cadre of expert T&E tool users.	OUSD(A) advocacy, Services execution.
T-10 Current configuration management practices begin too late to have value to the tester.	Establish policy that configuration management be initiated on day one of a software development project and extend throughout the software life cycle.	OUSD(A) advocacy, Services execution.
T-11 Changes are frequently introduced into software to resolve low level problems which affect overall performance.	Establish software development procedure that traces requirements from the beginning and introduces change only via requirements.	OUSD(A) advocacy, Services execution.
T-12 With the DoD downsizing, it is no longer a predominant market force in the world of software.	Adopt national practices and commercial standards concerning software tools.	OUSD(A) advocacy, Services execution.
T-13 Unnecessary documentation wastes resources and can hinder the tester in performance of duties	Adopt national practices in software documentation with paper documentation partially replaced by "electronic documentation" derived from the application of modern software tools.	OUSD(A) advocacy, Services execution.

Table 3 (Cont'd)
Tools Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
T-14 Some DoD standards tend to promote top-down grand scheme software designs which are very difficult to test.	Adopt national practices in widely accepted standards that were developed around the practical solution to a central technical problem.	OUSD(A) advocacy, Services execution.
T-15 Reusable software is often mistakenly viewed as a product which can be easily integrated without need for full scale testing.	Adopt national practices in software reuse in which testing is rigorous and linked to firmly defined requirements.	OUSD(A) advocacy, Services execution.
T-16 Many view re-engineering as a solution to legacy systems that require little testing.	Adopt national practices in re-engineering.	OUSD(A) advocacy, Services execution.
T-17 DoD has not adopted common software metrics.	Adopt national practices in measurements and their associated metrics to quantify the relative maturity of Defense software.	OUSD(A) advocacy, Services execution.
T-18 DoD has placed too high an emphasis on building an ICASE tool ahead of its time, with no formal test milestones.	Adopt national practices in ICASE with essential learning concerning the effective use of these methodologies.	OUSD(A) advocacy, Services execution.
T-19 Technology transition is crucial to DoD's market penetration in the area of software tools needed by the T&E community.	Adopt national practices in dual use to leverage corporate experience and cooperation.	OUSD(A) advocacy, Services execution.
T-20 DoD T&E professionals are not educated in software tools and their underlying methodologies.	Establish an education program and a policy to educate practitioners on the existence and benefits of software tools and the methodologies underlying tool use.	OUSD(A) advocacy, DSMC execution.

Table 3 (Cont'd)
Tools Working Group Recommended Actions

PROBLEM	RECOMMENDED ACTION	ACTIONEE
T-21 Traditional classroom training is not adequate to reach everyone.	Initiate and fund the development of an interactive distributed knowledge base concerning and involving software tools.	OUSD(A) advocacy, Services execution.
T-22 High speed networks are becoming active within DoD but may not be reaching all T&E professionals.	Provide funding to fully harness electronic data networks in the DoD T&E community as an information delivery mechanism from widely distributed data bases.	OUSD(A) advocacy, Services execution.
T-23 What knowledge that is available to the T&E professional concerning software tools is difficult to locate.	Provide a searchable software T&E oriented knowledge base that permits a user to easily navigate to topics of interest over a wide area search.	OUSD(A) advocacy, Services execution.
T-24 Program managers do not understand software and have no incentive to divert from existing techniques.	Educate and provide incentives to program managers to promote the use modern software development methodologies and tools in their programs.	OUSD(A) advocacy, Services execution.
T-25 Interoperability testing of software is hindered by lack of high level emphasis on interoperability.	Establish policy requiring software interoperability.	OUSD(A) advocacy, Services execution.
T-26 Massive regulatory doctrines slow and inhibit transition to the new software T&E methodologies.	Lobby for regulation relief.	OUSD(A)