DEPARTMENT OF DEFENSE

AUDIT REPORT

MANAGEMENT OF THE SOFTWARE TECHNOLOGY
FOR ADAPTABLE, RELIABLE SYSTEMS PROGRAM

No. 91-050

February 19, 1991

Office of the
Inspector General

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
ARLINGTON, VIRGINIA 22202-2884

February 19, 1991

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION
DIRECTOR, DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

SUBJECT: Final Report on the Audit of Management of the Software Technology for Adaptable, Reliable Systems Program (Report No. 91-050)

This is our final report on the Audit of Management of the Software Technology for Adaptable, Reliable Systems Program (STARS, or the Program) for your information and use. Comments on a draft of this report were considered in preparing the final report. The primary audit objective was to determine whether management of STARS was effective and efficient. Secondary objectives were to assess the Program's progress and evaluate the adequacy of related internal controls. The audit was made from October 1989 through June 1990. STARS is one of three major DoD efforts to reduce the costs of Mission-Critical Computer Resources (MCCR) software. The Program was begun in 1983; through 1990, management spent about $119 million on research and development to improve software productivity, quality, and reliability. In 1990, DoD spent an estimated $30 billion on MCCR software, and these costs may reach $42 billion by 1995.

Overall, we concluded that increased managerial attention is needed for STARS to meet its goals in a timely manner. The results of the audit are summarized in the following paragraphs, and the details, audit recommendations, and management comments are in Part II of this report.

While the audit showed that the management of STARS has recently improved, the Program had not progressed as planned. Following a major restructuring in 1986, STARS was to have been completed by 1992. However, because of substantial delays, management plans to continue STARS through 1995. STARS was affected by funding shortages. Although STARS was chartered as a joint DoD program, Service participation was minimal, and coordination with related research efforts needed to be enhanced to ensure efficient use of resources. Additionally, STARS had not developed clear goals and firm indicators of the Program's progress or value, and internal controls and oversight of the Program were not effective. STARS management had begun addressing these issues, but a more unified approach by DoD was needed. Since a DoD Software Master Plan is being developed, we

recommended that the Under Secretary of Defense for Acquisition direct, and provide appropriate support for, the Defense Advanced Research Projects Agency (DARPA) to identify adequate resources for timely Program completion. We recommended that the Under Secretary direct more Service participation, provide for STARS evaluations, and place related technical activities of the DoD Software Initiative under single management. We also recommended that DARPA establish a system to measure STARS progress and improve related internal controls (page 5).

We issued a draft of this report on August 31, 1990, and requested comments from the Under Secretary of Defense for Acquisition and the Director, DARPA. On behalf of the Under Secretary of Defense for Acquisition, the Director of Defense Research and Engineering provided comments on November 14, 1990, and we received DARPA's comments on November 20, 1990. Both responses were in compliance with DoD Directive 7650.3. The Comptroller of the Department of Defense also made comments, although we did not request them. All comments are shown in Appendixes B, C, and D.

The Director of Defense Research and Engineering generally commented that the draft report was inaccurate and misleading because it focused on problems of the past and did not fairly present recent improvements in the management of STARS. Additionally, the Director felt that our citation of a draft DoD Software Master Plan was inappropriate, and that some recommendations exceeded the audit's scope. Specifically, the Director of Defense Research and Engineering nonconcurred with Recommendation 1.d., which addressed consolidated management of the technical activities of the Ada Joint Program Office, the Software Engineering Institute, and STARS. He stated that the activities of each are not necessarily closely related, and that they are adequately coordinated. The Director concurred with the intent of Recommendation 1.c., which addressed enhanced oversight of STARS by DoD, but believed that recent DARPA changes in management structure and personnel provided adequate reviews to annually determine the Program's continuation. The Director fully or partially concurred with Recommendations 1.a.(1)., 1.a.(2)., and 1.b., which focused on more direct Service involvement in funding and managing the Program. The Director cited resource constraints and uncertain program execution roles for the Services, but he provided responsive action plans and completion dates that met the recommendations' intent.

We continue to believe that Recommendations 1.c. and 1.d. are sound. Our intent is to ensure effective DoD oversight of a major software research program and the more efficient use of limited resources. However, based on the comments received and on subsequent discussions with management, we revised our recommendations to express this intent more clearly. Accordingly, we request that the Under Secretary of Defense for Acquisition comment on our revised Recommendations 1.c. and 1.d.

The Director, DARPA concurred with our recommendations except for Recommendation 2.a.(1)., which required STARS to establish quantitative goals. DARPA stated that quantitative goals would be artificial and proposed that clear goals for each of STARS' technical areas would be more meaningful. We believe the proposal is a workable alternative to achieving our intent, and have revised Recommendation 2.a.(1). in the final report accordingly. We request that DARPA comment on this revised recommendation.

Although not a draft report addressee, the Comptroller of the Department of Defense concurred with all recommendations.

The audit identified internal control weaknesses as defined by Public Law 97-255, Office of Management and Budget Circular A-123, and DoD Directive 5010.38. DARPA concurred with our related recommendations and provided responsive corrective actions and estimated completion dates. These actions, when completed, should correct the internal control deficiencies identified.

DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Accordingly, final comments on the unresolved issues in this report should be provided within 60 days of the date of this memorandum. Your comments should indicate concurrence or nonconcurrence with the finding and each unresolved recommendation. If you concur, describe the corrective actions already taken or planned and give the completion dates for actions already taken and estimated dates for completion of planned actions. If you nonconcur, state your specific reasons. If appropriate, you may propose alternative methods for accomplishing desired improvements. The audit quantifies no potential monetary benefits, but Appendix E summarizes nonmonetary benefits.

The audit team (listed in Appendix G) appreciates the courtesies extended. If you have any questions about this audit, please contact Mr. Terry McKinney at (703) 693-0430 (AUTOVON 223-0430) or Mr. James Hutchinson at (703) 693-0452 (AUTOVON 223-0452). Copies of the this report are being provided to the activities listed in Appendix H and will be made available to other interested parties.

Robert J. Lieberman

Robert J. Lieberman
Assistant Inspector General
for Auditing

cc:
Secretary of the Army
Secretary of the Navy
Secretary of the Air Force

MANAGEMENT OF THE SOFTWARE TECHNOLOGY FOR ADAPTABLE, RELIABLE SYSTEMS PROGRAM

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Prepared by:
Financial Management Directorate
Project No. 0FE-0007

MANAGEMENT OF THE SOFTWARE TECHNOLOGY FOR ADAPTABLE, RELIABLE SYSTEMS PROGRAM

PART I - INTRODUCTION

Background

Mission-Critical Computer Resources (MCCR) are computer hardware and software components that are integral to the functioning of weapon systems and other critical military and intelligence systems. Almost all DoD weapon and support systems depend on MCCR subsystems for some degree of operational control. Software (the instructions and data definitions that enable computer hardware to function) has become an important and costly part of DoD's mission-critical systems. Between 1990 and 1995, MCCR hardware is expected to cost about $6 billion annually, while related software costs are expected to grow from about $30 billion to $42 billion. Further, because software has considerable control over system functions, software deficiencies often affect the performance and delivery of weapon systems. Problems with performance and delivery can cost much more than the software itself. In the next few years, economic pressures and personnel shortages will probably result in more automation of DoD's mission-critical systems.

The role of software in contemporary weapon systems is substantial and complex and is increasing in importance. While the C5-A aircraft required about 25,000 lines of software, about 750,000 lines of software are needed for the C-17A, DoD's newest airlifter. Planners expect that the Advanced Tactical Fighter will require nearly 7 million lines of software. Advances in technology have provided most of the required hardware capabilities, but have not kept pace with DoD's escalating needs for affordable and reliable MCCR software. In 1987, the Defense Science Board Task Force on Military Software reported that:

> ...The "smarts" of smart weapons are provided by software. Software is crucial to intelligence, communications, command, and control... The chief "military software problem" is that we cannot get enough of it, soon enough, reliable enough, and cheap enough to meet the demands of weapon systems designers and users....

DoD's software problem has caused cost overruns and has delayed the fielding of weapon systems. In the late 1970's and early 1980's, DoD began major initiatives to alleviate MCCR software problems. One initiative was the Software Technology for Adaptable, Reliable Systems Program (STARS, or the Program), which was established to improve the productivity, quality, and adaptability of MCCR software. The Program focused on improving the technology and processes that support the creation and

evolution of software. STARS is a research and development program with three primary thrusts: to adapt modern processes for developing and maintaining software; to provide highly automated environments for creating and maintaining software; and to efficiently reuse previously developed software.

STARS was funded in 1983 and chartered in 1984 as a joint DoD program. After the Program was substantially revised in 1986, management planned for STARS to end in 1992; STARS' results were to be transferred to the Services' functional organizations beginning in 1989. A total budget of about $188 million was expected for FY's 1986 through 1990. By January 1990, however, STARS management expected that the Program would continue through FY 1995. For the period FY 1986 through FY 1990, STARS will have cost about $99 million, and if planned work is executed, DoD will have invested over $160 million in STARS by the end of FY 1995.

Objectives and Scope

Our primary audit objective was to determine if management of the STARS Program was effective and efficient. Secondary audit objectives were to assess STARS' progress in achieving its goals and to evaluate the adequacy of related internal controls. We reviewed STARS records and related records created since STARS' inception, focusing on the period August 1986 through June 1990.

To evaluate program management and assess STARS' progress, we examined plans, schedules, reports, and other program documentation. We discussed managerial, administrative, and technical aspects of STARS with the Office of the Secretary of Defense, the Defense Advanced Research Projects Agency (DARPA), the Services, and other DoD and Federal officials. We also discussed STARS with contractors and other knowledgeable private-sector personnel. We did not perform detailed audit work at other DoD activities where similar research was being done on software.

We examined and analyzed DARPA's internal control procedures and requirements related to program oversight and review. We also identified and evaluated STARS program management controls. We reviewed and analyzed STARS management control procedures and requirements for program administration, contract administration, and program review. Appendix F lists the activities we visited or contacted.

This program audit was made from October 1989 through June 1990. The audit was made in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD, and accordingly included such tests of the internal controls as were considered necessary.

Internal Controls

We reviewed DARPA's internal controls for the oversight and management of the STARS Program. We found that DARPA's overall program management control procedures and requirements were generally adequate, but had not been applied to STARS and needed to be strengthened. Although STARS qualified as a major program, DARPA had not designated it as such; therefore, STARS management was not required to develop detailed program plans and undergo frequent review by DARPA officials. Additionally, DARPA had not developed procedures to ensure that major programs are consistently identified.

We also evaluated STARS' program management controls. Program management controls had not been updated since 1986, and associated procedures and requirements did not reflect the substantial changes in STARS since that time. Additionally, the objectives of the control procedures were not uniformly met. Program documentation was seriously deficient. Management could not readily provide historical fiscal records, show how project expenditures met STARS goals and objectives, or show the need for substantial changes that had been made in the Program. Also, the Program's relationship with other organizations had not been established through memorandums of understanding.

Completion of actions begun by management during the audit and implementation of our recommendations in Part II of this report should correct the internal control deficiencies.

Prior Audit Coverage

We identified no prior audits of STARS, but the Program has been the subject of past reviews and studies. "An Assessment of the STARS Program, September-October 1985," issued in December 1985 by the Institute for Defense Analysis, concluded that STARS faced critical managerial problems and that the Program should encourage more industry involvement in achieving its objectives. The study recommended that a program director be appointed and given appropriate authority. It also recommended that STARS shift its focus away from developing complete, wide-spectrum environments, and toward the development of a general framework for using a variety of software tools and the production of compatible sets of tools. These recommendations led to a restructuring of STARS, and were largely reflected in the Program's management and technical plans, which were developed in 1986.

In 1984, the Defense Science Board Task Force on Military Software was asked to address managerial and technical changes needed to improve the software acquisition process within DoD, and was also asked to assess STARS. The Task Force concluded that STARS was an important effort, but needed to be better coordinated with other DoD initiatives in software technology and methodology; that more specific goals and plans needed to be developed; and that Program management needed to be strengthened.

The Task Force recommended:

- the creation of a Joint Program Office to oversee STARS, the Ada Joint Program Office, and the Software Engineering Institute;

- that the major software technology programs develop a coordinated plan;

- that STARS management define a new set of program goals and develop an implementation plan which emphasized visible, early milestones; and

- that STARS management choose several software programs in early development phases and augment the funding of the programs to ensure the use of modern software practices and tools.

As discussed in Part II of our report, these recommendations have not been fully implemented.

PART II - FINDING AND RECOMMENDATIONS

Program Management

FINDING

Management of the Software Technology for Adaptable, Reliable Systems Program (STARS, or the Program) was not fully effective and efficient in planning, developing, executing, and controlling STARS. Resource constraints and inadequate coordination hindered program implementation as set forth in the most recent STARS Program Management Plan. Also, while the Program was chartered to improve software productivity and quality, management had not established a performance baseline and quantitative methods of measuring improvements. Inadequate management controls also contributed to program difficulties. Achievement of the Program's goals and realization of its potential benefits may not be possible without increased management attention.

DISCUSSION OF DETAILS

Background. STARS was funded in 1983 and was chartered in 1984 as a joint DoD program. After making little progress during its first few years, the Program underwent several reviews. In 1986, the Program's fourth manager was appointed and given enhanced execution authority. STARS' technical thrusts were revised and the changes were incorporated into the Program's technology and management plans. STARS was to develop software technology and demonstrate program results through four major activities.

- Different technology approaches would be developed by competing prime contractors, and management would choose the best alternative for the contractors to develop cooperatively.

- Funds would be provided to the Services for software research and development consistent with STARS goals.

- Through its Foundations projects (contracts to develop several software tool prototypes), the Program would enhance the existing base of tools for Ada-based systems.

- To demonstrate and measure the benefits of these efforts, management planned a series of Shadow projects (parallel development of mission-critical applications, using STARS-developed software engineering products and processes) to be executed by the Services.

In April 1988, the STARS Joint Program Office was transferred from the Office of the Secretary of Defense (OSD) to the Defense Advanced Research Projects Agency (DARPA). Also in 1988, the

Program's prime contractors were competitively selected. The overall goal of STARS is to increase the productivity, quality, and reliability of MCCR software by adapting modern software engineering practices to the specification, development, operation, maintenance, and retirement of DoD software. To achieve this goal, management has directed the contractors to focus on three primary areas: improved software engineering processes and associated technologies; adaptable software engineering environments using integrated, commercially-available tools; and improved repositories and processes for software reuse.

The DoD Software Initiative commonly refers to STARS and two other programs. The three programs are interrelated and are aimed at reducing the costs of MCCR software. The Ada Joint Program Office (AJPO), managed by the Director of Defense Research and Engineering, maintains and updates the Ada programming language. DoD developed Ada specifically to reduce the life-cycle costs of software; in 1983, Ada was designated as DoD's standard language for MCCR applications. In 1984, DoD established the Software Engineering Institute (SEI) at Carnegie-Mellon University. Its purposes are to develop software engineering concepts with high potential and to promote the use of advanced software engineering techniques and methods throughout the MCCR software industry. Like STARS, the SEI is funded and managed by DARPA.

Resource Constraints. The execution of STARS, as planned in 1986, was slowed by factors beyond the program director's control. Planned financial resources did not materialize. For FY's 1986 through 1990, management planned on resources of about $188 million; however, only $105 million was allocated. Further, about $6 million of this allocation was reprogrammed to other projects, leaving about $99 million available for STARS. Appendix A illustrates the planned and actual funds available for each major Program activity. These shortages have reduced research by the prime contractors, eliminated complementary software research efforts by the Services, and ended the Shadow projects.

Program management contracted with three prime contractors to competitively develop alternate technology approaches to solving problems. However, lack of funding has reduced the number of approaches that contractors can competitively explore.

Another objective of management was to enable software to be securely developed using distributed processing at physically separate locations, with different hardware used at each location. However, funds have not been available to accomplish this objective. Security requirements should be addressed during

the initial development phase. When security measures have to be developed and retrofitted at a later date, the costs can be 50 to 100 times greater.

To encourage Service involvement and participation, the 1986 STARS Program Management Plan stated:

> ...Funding has been allocated to each Service to fund STARS efforts and participation by Service laboratories...to help achieve the cost and quality benefits sought through STARS in Service programs....

For FY's 1986 through 1990, the amount of funding planned for Shadow projects was about $24 million; about $38 million was planned for other STARS-related research efforts. Through FY 1988, management allocated about $7 million to the Services for six Shadow projects and about $14 million for related software research projects. In FY 1989, management stopped allocations to the Services and has not restored funding, although the Services have made several requests for funds to complete research projects.

In our opinion, funding limitations will continue to affect the STARS Program. STARS management has made plans to produce three fully functional software engineering environments, each configured to support a specific functional software domain such as command and control or avionics. Projected funding is not adequate to achieve this objective. A software engineering environment being developed by the Army has cost about $30 million, and substantial further investment will be required to complete this effort. Additionally, a complete environment for developing large administrative software systems is estimated to cost about $50 million. For FY's 1991 through 1994, STARS' total budget is about $61 million.

The STARS Joint Program Office (JPO) was not staffed according to the 1986 plans. These plans showed that the STARS JPO would consist of a director, deputy directors from each of the Services, and technical and clerical staff. Appropriate personnel positions were allocated, but the positions were never fully staffed. The Navy assigned a deputy director on a part-time basis. The Defense Logistics Agency also provided administrative assistance. When the Program was transferred from OSD to DARPA, this limited support was lost, and STARS was managed by one person. In our opinion, one person cannot effectively manage a program such as STARS.

Related Programs. Although STARS was chartered as a joint program, there has been little active participation by the Services. Also, STARS activities have not been well-coordinated with other software research. This has led to the funding of similar (possibly duplicate) research projects within DoD.

Additionally, AJPO, SEI, and STARS managers need to better coordinate their efforts, since their program goals are closely related.

As previously discussed, the Services provided little support to the STARS JPO. Service program managers administered STARS-sponsored Shadow projects and other research, but the STARS JPO was severely understaffed, and the Program was a joint DoD effort in name only. As a result, STARS contributed funds to Service projects, but these projects were not effectively coordinated. Present management no longer considers STARS a joint program and intends to alter the Program's charter accordingly. However, STARS management has recently begun better coordination with other Service research projects, such as software repositories and methods of measuring software attributes.

The preliminary draft of the DoD Software Master Plan, issued February 9, 1990, outlines a consolidated DoD approach and actions needed to address problems resulting from the escalating use and costs of software in defense systems. Part of the Plan attempts to identify and categorize all of DoD's unclassified software research efforts. It summarizes research projects on several aspects of software, from the shortage of qualified software personnel to software security. The plan lists several projects that are similar to STARS activities and may duplicate them. For instance, one of the main thrusts of STARS is the development of software engineering environments. At least 17 other environment-related projects are listed in the Software Master Plan.

Since STARS and SEI goals are similar, STARS management planned in 1986 to work closely with SEI to coordinate technical developments and transition the Program's products into early use. The relationship was initially successful, but declined due to misunderstandings and funding difficulties. In March 1989, the SEI terminated STARS-sponsored work, which included preliminary efforts to measure and compare the effectiveness of Shadow projects. STARS management has begun efforts to involve SEI in STARS activities again. In our opinion, SEI can contribute to the software engineering processes being developed by STARS. SEI participation can also speed up the widespread use of STARS products by the MCCR software community.

In 1987, to strengthen the AJPO, SEI, and STARS, and to permit easier coordination of common goals and objectives, the Defense Science Board's Task Force on Military Software recommended that DoD place the three programs under common management. DoD officials did not implement the recommendation because AJPO's primary mission was policy-making rather than technical, and moving the AJPO might convey the impression that DoD was not committed to using Ada. We believe these factors are no longer fully valid. We found little reason to doubt DoD's commitment to

Ada. Additionally, while most of AJPO's technical activities are directly related to maintaining the Ada programming language and standard, some are not. By bringing the related technical activities of the DoD Software Initiative under a single manager, these technical efforts could be better coordinated and more efficiently executed. For instance, we believe that the AJPO's Ada Technology Insertion Project could be used to demonstrate the usefulness of STARS products as well as the suitability of the Ada programming language in meeting the requirements of MCCR applications.

As previously noted, management has recently focused on improved coordination with the Services and with related research programs. However, we believe that a more integrated DoD approach to STARS and other software technology programs would result in more efficient use of DoD resources, and would help to ensure that some issues not directly addressed by STARS receive attention in other research.

Program Goals and Measurements. STARS management had not specified goals, established a system for measuring progress in goal achievement, or effectively demonstrated its accomplishments. Management did not plan to quantify or fully demonstrate program results until STARS nears completion. In the interim, evaluating STARS' progress is highly subjective.

STARS' goals were to improve the productivity, quality, and reliability of MCCR software; to promote the development and application of reusable software; and to reduce the costs and development time of defense software. However, management had specified only one goal, a tenfold increase in productivity. Management also had not established a performance baseline from which progress could be quantified or evaluated.

One of the Program's original thrusts was to measure improvements resulting from the processes and products produced by the Program. However, STARS had not selected and implemented a system to measure software attributes, primarily because the software industry has no measurement standards. In the absence of concrete standards, numerous methods of software measurement have been developed and are selectively used by many software managers. STARS management needed to select, implement, and continually use a measurement system to establish a performance baseline and track goal accomplishment and program progress.

In 1985, the STARS Goals and Objectives Working Group reported that STARS:

> ...has the responsibility for demonstrating improvement over the current situation. It should establish exactly what the current baseline is and keep this knowledge up to date as improvements are made over time. It should assure demonstrations showing improvement (as opposed to demonstrations showing value) are made. In particular, it should assure that improvement in the productivity, reusability, reliability and adaptability are demonstrated....

A series of 12 Shadow projects, starting in 1987, was to demonstrate the gains resulting from STARS-produced software tools and environments. Because of contracting delays, however, enhanced software tools could not be developed quickly enough to be used in the Shadow projects. Although the Shadow projects have developed Ada-based software for weapon systems, they have not demonstrated gains in software productivity, reliability, or adaptability resulting from the use of STARS products.

Because there was little evidence of concrete achievement, the Program was increasingly criticized inside and outside DoD. Management needed to more effectively demonstrate interim accomplishments. A measurement system would help track program progress, provide a better base for program execution, and support funding requests. Additionally, STARS economic value cannot be determined until its improvements are quantified.

Internal and Program Management Controls. Internal controls over and within STARS needed to be strengthened. To assure that the Program is executed in a timely manner, senior DARPA management needed to review STARS more closely and require more detailed planning information from STARS management. Additionally, STARS' program management controls were outdated and did not ensure that control objectives were met.

DARPA Instruction 13, "DARPA Program Management Procedures," gives program management procedures and requirements. It requires DARPA-sponsored research programs that exceed life-cycle costs of $100 million, or are of other special interest, to be designated as major programs. Major programs must develop more detailed program plans and undergo more frequent review by senior DARPA officials. STARS had not been designated as a major program by DARPA; therefore, STARS program reviews were not as frequent or as stringent as those required for a major program. Reviews focused on budgetary issues, not on program execution or progress. Records were available for only the most recent review of STARS; records of prior reviews had been destroyed because of limited file space.

We were informed that the Director of DARPA determined whether a program should be classified as major. However, we could not identify procedures for presenting the Director with information about criteria for major programs. To ensure that DARPA programs received appropriate oversight, procedures needed to be developed and implemented that would help the Director make consistent decisions on program classification.

The 1986 STARS Program Management Plan described program management control objectives, procedures, and requirements. Although one of the requirements was that the plan be updated annually, management had not updated it. As a result, the plan and its management controls were outdated. It did not reflect the organizational, financial, and program execution changes in STARS since 1986. Additionally, procedures for maintaining adequate program documentation were ineffective.

Management could not provide adequate records of the Program's fiscal history. Financial summaries and records prior to 1986 were unavailable, and although the records for 1986 through April 1988 showed STARS budgets and allocations, they contained little information about expenditures. Since STARS reallocated most of its funds to the Services during this period, we asked the Services to explain how they spent the funds. Only the Air Force could readily account for its use of STARS funds. Although we found no evidence of fraud, we could not identify the ultimate use of about $4.3 million in STARS funds. Additionally, we could not tell whether STARS management had required that funds allocated to the Services be spent to further STARS goals or meet any specific, agreed-upon needs.

Since STARS had been transferred to DARPA, DARPA's financial accounting system and internal procedures provided an audit trail of expenditures. However, STARS program files did not give the program director (under DARPA, the Program Manager) the information he needed about STARS' financial and program execution history to avoid repeating past mistakes.

Program Improvements. During our audit, program officials independently initiated several actions to improve STARS management and responded to some of our concerns. These actions should improve program effectiveness and increase the Program's chances of success.

STARS' contracting agent, the Air Force's Electronic Systems Division, has improved its administration of STARS' prime contracts. Reviews of contractor actions and deliverables have been formalized and strengthened. Of the 209 deliverables due on or before January 11, 1990, 38 (18 percent) were more than 90 days past due. On April 30, 1990, 29 (10 percent) of 299 deliverables were more than 90 days past due. Actions have

been initiated to further improve contractors' timeliness. Increased technical expertise is available to monitor contractors, and subcontracting procedures have been established to reduce or prevent delays.

DARPA placed STARS in its Information Science and Technology Office, where STARS and other related research can be better coordinated. Working relationships with the Services and other related organizations have been improved, and memorandums of understanding are being negotiated to formalize the responsibilities and interests of each. Management has arranged for technical and program advice from the Joint Advisory Committee, which is composed of senior representatives from each Service. To promote the visibility of STARS, several prototypes of software tools developed under STARS have been released to the public. Further, management has begun updating the Program Management Plan.

Conclusions. Although DoD has generally supported the aims of STARS, management has not been able to execute the Program as planned. Many difficulties, such as short management tenures and declining resources, have been beyond the control of management and have hindered the Program's progress. STARS addresses broad and complex issues that will not be resolved overnight. However, the Program has produced little firm evidence of interim accomplishment, and the need for its continuation has been questioned.

Recent management initiatives should help correct some of STARS' problems. However, considering the risks of a research program such as STARS, its history of problems, and the program and technical issues still unresolved, these actions should be speeded up. Additionally, enhanced program oversight and review would help ensure that STARS accomplishes its goals in an effective and timely manner.

Improving the cost-effectiveness and quality of DoD software is a worthwhile goal, but an integrated DoD decision on the future role of STARS, and an appropriate level and course of action, are needed. To make the best use of limited resources, DoD needs to respond to a basic question: Is the next investment in STARS worthwhile, or can the funds be better applied elsewhere?

RECOMMENDATIONS FOR CORRECTIVE ACTION

1. We recommend that the Under Secretary of Defense for Acquisition, in consonance with the DoD Master Software Plan under development:

a. Direct, and provide appropriate support for, the Defense Advanced Research Projects Agency to:

(1) identify, in coordination with the Services, adequate resources for the Software Technology for Adaptable, Reliable Systems Program, and

(2) develop concrete financial plans to complete the Software Technology for Adaptable, Reliable Systems Program in a timely manner.

b. Direct each of the Services to assign a representative to work directly and be collocated with the Program Manager of the Software Technology for Adaptable, Reliable Systems Program.

c. Provide for an independent annual evaluation of the Software Technology for Adaptable, Reliable Systems Program. The evaluation should focus on the Program's progress in meeting its objectives and goals, and whether its accomplishments merit Program continuation.

d. Consolidate the management of related technical activities that could more efficiently serve the joint purposes of the Ada Joint Program Office, the Software Engineering Institute, and the Software Technology for Adaptable, Reliable Systems Program.

2. We recommend that the Director, Defense Advanced Research Projects Agency:

a. Require the Software Technology for Adaptable, Reliable Systems Program to:

(1) establish clear goals for each technical area,

(2) document a performance baseline, and

(3) select and implement a system for measuring progress in goal achievement.

b. Require the Program Manager to develop, document, and maintain an effective system of management control objectives, requirements, and procedures unique to the Software Technology for Adaptable, Reliable Systems Program and incorporate them into a revised Program Management Plan.

c. Designate the Software Technology for Adaptable, Reliable Systems Program as a major program and manage it accordingly.

d. Develop and implement procedures to consistently identify major programs as defined in Defense Advanced Research Projects Agency Instruction No. 13.

MANAGEMENT COMMENTS

The Director of Defense Research and Engineering (the Director) generally commented that the report was inaccurate, unfairly criticized program execution, focused on past problems and did not adequately recognize program management improvements initiated during the audit period, repeated a prior recommendation, and was not limited to its stated scope. The Director also stated that it was inappropriate to make our recommendations in terms of the draft DoD Software Master Plan since it had not been finalized and approved.

In responding to our specific recommendations, the Director fully or partially concurred with Recommendations 1.a.(1)., 1.a.(2)., and 1.b. and provided action plans that met the recommendations' intent and should be completed by the end of FY 1991. While citing budget restrictions, the Director stated that additional funding has been identified in DARPA's budget submission; when combined with investments in compatible technology by STARS contractors, this funding is adequate to make STARS viable. STARS management is developing a detailed execution plan, which will be reviewed to determine if funding requests are reasonable. The plan will provide more linkage between products and funding required. Additionally, STARS management and the Services are defining the Services' involvement in program execution. Commensurate Service financial and program management roles will be determined later.

The Director concurred with the intent of draft report Recommendation 1.c., which required an annual program evaluation by high-level DoD officials, but believes that an adequate review framework currently exists due to recent DARPA changes in management structure and personnel. The Director nonconcurred with Recommendation 1.d. in the draft report, which addressed consolidated management of the DoD Software Initiative's technical activities. The Director felt that the AJPO's technical activities were not closely related to those of the SEI or STARS and stated that there is adequate coordination with the STARS Program. The complete text of comments from the Director of Defense Research and Engineering is shown at Appendix B.

The Director, Defense Advanced Research Projects Agency concurred with Recommendations 2.a.(2)., 2.a.(3)., 2.b., 2.c., and 2.d. DARPA provided action plans for each recommendation, with all actions to be completed by the end of FY 1991. DARPA is formulating plans to develop a performance baseline and has tasked the SEI to develop the framework for measuring Program progress and achievements. An internal control system for the STARS Program is being developed and will be set forth in the revised Program Management Plan. The revised STARS Program Management Plan will also serve as the detailed program plan

required by DARPA when it designates STARS as a major program. DARPA will, as part of ongoing review of its management systems, develop and implement procedures to consistently identify major programs. DARPA partially concurred with Recommendation 2.a.(1)., which required STARS to establish quantitative program goals. Stating that quantified goals would be artificial, DARPA proposed that establishing clear goals for each technical area would be more meaningful. The complete text of comments provided by the Defense Advanced Research Projects Agency is shown at Appendix C.

The Comptroller of the Department of Defense concurred with all draft report recommendations, and the complete text of the comments is shown at Appendix D.

AUDIT RESPONSE TO MANAGEMENT COMMENTS

After our draft report was issued, we met with management officials to better define the inaccuracies cited in the response from the Director of Defense Research and Engineering. One example was the number of STARS program directors between 1983 and 1986. The Director of Defense Research and Engineering believed that our source of information was incorrect and that there were three different program directors before the major program reorganization in 1986, not the four implied in our draft report. We believe that either number indicates a troubled program. The Director also believed that our description of the objective of an improved software engineering process was too narrow. We agree that our description reflected a prior STARS Program focus. For both points, we have appropriately revised the final report.

However, we continue to believe that the audit report fairly and objectively presents STARS' problems and related improvements. We agree with the Director of Defense Research and Engineering that the Program's management was strengthened during our audit, but many recent management initiatives are not complete. Therefore, the results of these initiatives and attendant reductions in program risk are not conclusive. We also believe the report clearly presents the impact of resource shortages on planned STARS execution.

We cited the draft DoD Software Master Plan because it represents DoD's first consolidated approach to addressing the extremely high costs of software. We doubt that the final Master Plan will differ substantially from the draft. Therefore, we believe the draft DoD Software Master Plan can and should be used to focus and guide the high-level administration of DoD software research.

Our report recognizes recent managerial improvements initiated by DARPA and STARS. Additionally, the implementation of the recommendations that DARPA has concurred with should further

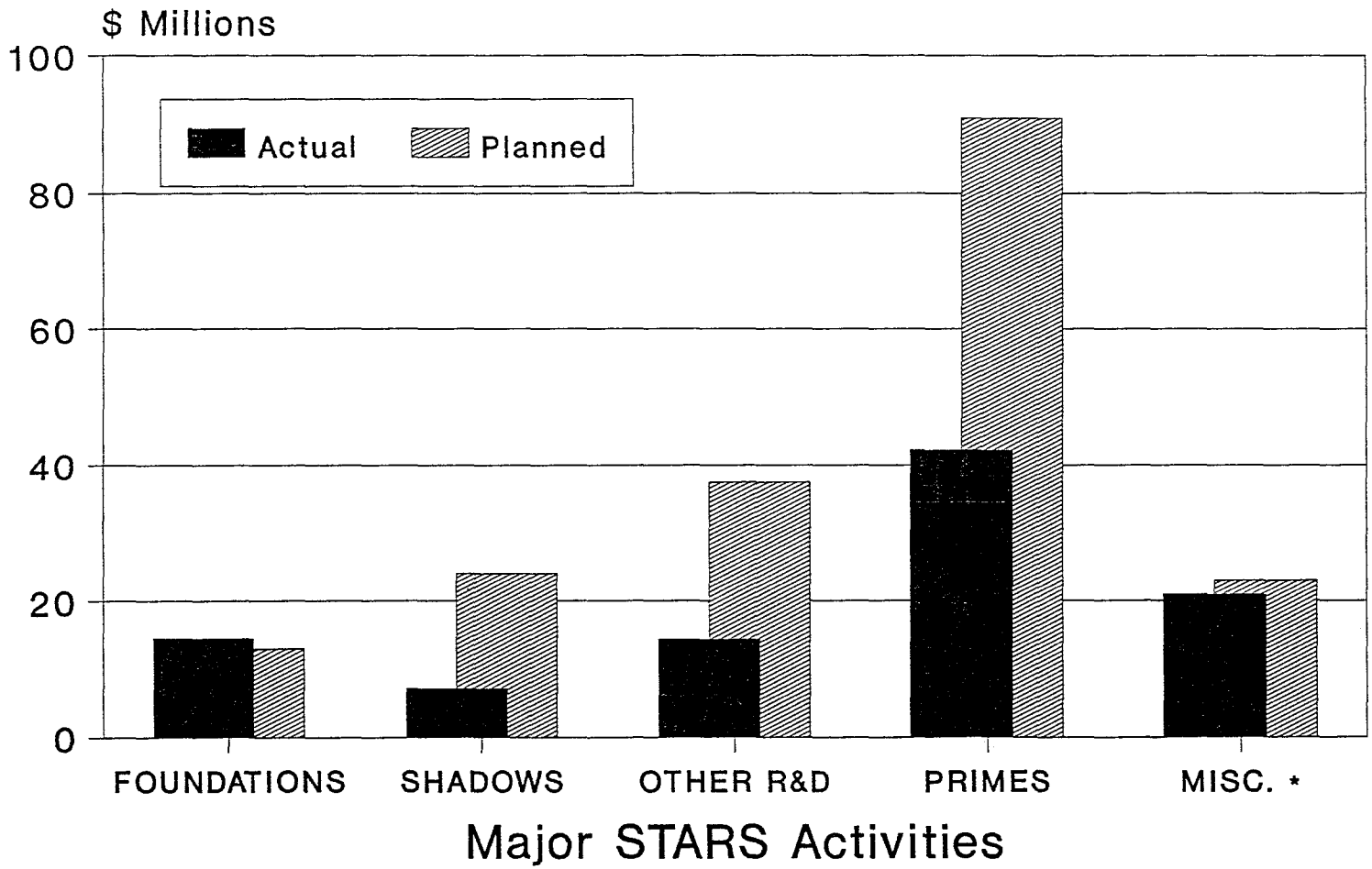
strengthen the management of STARS. We continue to believe, however, that past program difficulties, the risks involved, and the relative lack of clearly demonstrated accomplishment show a need for more oversight of the STARS Program. STARS holds the promise of substantial contribution to the goals of the draft DoD Software Master Plan, and while the Program's past and potential costs are high, STARS has not been subjected to intensive review. In our opinion, these factors merit thorough, high-level DoD review of the Program on a periodic basis. We also believe that increased high-level involvement with STARS would provide more informed and coordinated DoD execution of the finalized DoD Software Master Plan.

Our report does not duplicate an earlier recommendation by the Defense Science Board. The Defense Science Board recommended the joint management of all activities of the AJPO, SEI, and STARS; we recommend that the manager responsible for STARS and SEI also be in charge of the AJPO's technical projects that are not directly related to Ada maintenance. While the AJPO was not specifically included in our announced audit objectives, we believe that a recommendation directed at the AJPO is appropriate, since the AJPO is a component of the DoD Software Initiative. We also continue to believe that related technical activities of the AJPO and STARS can be more efficiently managed on a consolidated basis. Contrary to the Director's assertion, we found very little indication that the activities of the AJPO and STARS were coordinated. While the AJPO's focus is on the maintenance, improvement, and standardization of the Ada programming language, it administers projects that we believe are closely related to STARS activities. For instance, the AJPO has a current project concerning the Common Ada Programming Support Environment Interface Standard, which is also central to STARS' efforts to establish a framework for interfacing the various components of a software engineering environment. As discussed in the report, we also believe that the AJPO's Ada Technology Insertion Project could be used for the joint purposes of the two programs.

The intent of our draft report recommendations was to provide effective DoD oversight of a major software research program and to ensure the more efficient use of limited DoD resources. Based on management comments, we have revised the disputed recommendations in the final report to better express our intent. Accordingly, we request that the Under Secretary of Defense for Acquisition reconsider his position on these issues and respond to our revised Recommendations 1.c. and 1.d. in the final report.

DARPA's response included an acceptable alternative for implementing the intent of Recommendation 2.a.(1). Accordingly, we have revised this recommendation in the final report to reflect the planned actions, and we ask that DARPA respond to the revised recommendation.

LEVEL AND USE OF STARS FUNDS
(Planned and Actual, FY 86-90)



* Actual includes $4.3 million for which we could not identify an ultimate use.

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

14 NOV 1990

MEMORANDUM FOR THE INSPECTOR GENERAL, DEPARTMENT OF DEFENSE

SUBJECT: Draft Report on the Audit of the STARS Program (Project No. OFE-0007), dated August 31, 1990.

We recognize the significant effort expended to obtain an understanding of the background and evolution of the Software Technology for Adaptable, Reliable Systems (STARS) Program. However, some of the subject draft audit report findings are inaccurate, and some of its recommendations are inappropriate. During the report period, October 1989 to June 1990, efforts had already been made to correct many of the past problems cited in the report. While there is some acknowledgement in the report that management of the program has improved, its recommendations appear to be influenced by problems of the past. We believe the STARS Program has made significant progress since the time of the audit in the areas of program management structure, the program management team and the existing controls to successfully manage and complete the current program.

Although we commonly refer to the software development process, it is not a singular well-defined set of methods and activities, and is not yet a true engineering discipline. However, our dependence on software is such that we must act to improve the process whether it embodies a mature engineering discipline or not. Under these circumstances, we should expect that a research and development program like STARS, whose main objective is to develop means to improve this process, will be refined and adjusted as our experience with the process and its evolving methods, techniques and tools grows.

Remedies to most of the problems cited in the Audit Report have already been implemented by the current Program Manager. Our specific responses to the recommendations are provided in the attachment.

Charles Herzfeld

Charles M. Herzfeld

Attachment

COMMENTS ON
OIG DRAFT REPORT ON THE AUDIT OF THE STARS PROGRAM
(PROJECT NO. OFE-0007), DATED AUGUST 31, 1990

GENERAL COMMENTS

The Audit Report on the Software Technology for Adaptable, Reliable Systems (STARS) Program (Project No. OFE-0007) expended significant effort to obtain an understanding of the background and evolution of the program. However, some of its findings are inaccurate, and some of its recommendations are inappropriate. During the report period, October 1989 to June 1990, efforts had already been made to correct many of the past problems cited in the report. While there is some acknowledgement in the report that management of the program has improved, its recommendations appear to be influenced by problems of the past. We believe the STARS Program has made significant progress since the time of the audit in the areas of program management structure, the program management team and the existing controls to successfully manage and complete the current program.

In one instance, the report has merely repeated an earlier recommendation to consolidate the Ada Program, the STARS Program, and the Software Engineering Institute Program without additional rationale. This recommendation was first proposed by a Defense Science Board Task Force under different circumstances. At that time, the recommendation was specifically evaluated in light of the Ada Joint Program Office's mission, and rejected by OSD management as inappropriate. An explanation of the rationale for rejection is included in the response to the recommendations below. Furthermore, this recommendation was outside the intended scope of the Audit Report.

The report cites a major restructuring of the program in 1986, and mentions the fact that continued shortfalls in program funding have caused continued cutbacks and adjustments in the planned effort and objectives. The criticism that STARS management did not execute the program as originally planned was inappropriate, since replanning has necessarily occurred along the way. A valid criticism would be that STARS Program Management should have formally documented revisions of the program objectives and plans each year as they occurred. The current Program Manager is in the process of formally updating the Program Plan. It will be available to the OIG when it is completed and approved.

The report is critical of the STARS Program's provisions for participation by the Services. It does not acknowledge the fact that the Services initially had representatives in the Program Office and unilaterally chose to remove them. The opportunity for Service participation in planning and managing the program has always been there. In addition, it should be obvious that reduced funding would necessarily reduce the ability of the

program to fund Service's proposed efforts, and that the available resources would be focused on the most central parts of the program, namely the Competing Primes. Nevertheless, DARPA has already taken the initiative to work more closely with the Services to expand their involvement.

Although we commonly refer to the software development process, it is not a singular well-defined set of methods and activities, and is not yet a true engineering discipline. However, our dependence on software is such that we must act to improve the process whether it embodies a mature engineering discipline or not. Under these circumstances, we should expect that a research and development program like STARS, whose main objective is to develop means to improve this process, will be refined and adjusted as our experience with the process and its evolving methods, techniques and tools grows.

The comment in the report that "The main objective of an improved software engineering process is to allow software to be designed before hardware is selected," totally misses the mark on what a software engineering process is, and why the improvements are needed. Making a selection decision on the computer hardware for a software intensive system prior to designing that software is usually a reflection of poor management judgement, and more often than not leads to disaster later in the program. Although correcting such management practice is very important, it is unrelated to the objective of improving the software engineering practice. The true objective is to achieve higher quality, more reliable, more maintainable software, in a more cost effective and consistent manner.

RESPONSE TO DRAFT AUDIT REPORT RECOMMENDATIONS

The report recommendations are repeated below, followed by the OUSD(A) and DARPA responses and comments:

1. We recommend that the Under Secretary of Defense for Acquisition, in consonance with the developing DoD Software Master Plan:

[Comment: The DoD Software Master Plan is currently in coordination. It is inappropriate to cite such a Plan in the Audit Report before it is finalized and approved.]

a. Direct, and provide appropriate support for, the Defense Advanced Research Projects Agency to:

(1) identify, in coordination with the Services, adequate resources for the Software Technology for Adaptable, Reliable Systems Program, and

RESPONSE: Partially concur. DARPA has already identified additional resources in the current Budget Estimate Submission. This level of funding, when combined with industry investment in STARS compatible technology by the STARS Primes, is adequate to build a viable STARS capability. While some additional funding would be beneficial, it cannot be accommodated under the current austere and uncertain budget environment. The role of the Services is primarily one of transitioning and exploiting the products of the STARS Program. The STARS Program Manager is already working closely with the Services to define how their role should be executed in the current program. Any required Service funding will be identified when the Services' efforts are fully defined.

Corrective action has been initiated. Completion is expected by the end of FY 1991.

(2) develop concrete financial plans to complete the Software Technology for Adaptable, Reliable Systems Program in a timely manner.

RESPONSE: Concur. STARS has suffered seriously from organizational problems and significant loss of funding in the past. DARPA transferred the STARS Program to the Information Science and Technology Office in November 1989, in order to ensure appropriate planning, technical oversight, and budget review. Since that time DARPA has included increased funding in its Budget Estimate Submission. A next level detailed execution plan with an associated review of resource reasonableness is in progress. This plan will provide more detailed traceability between funding elements and incremental products.

Corrective action has been initiated. Completion expected by end of FY 1991.

b. Direct each of the Services to assign a representative to work directly and be collocated with the Software Technology for Adaptable, Reliable Systems Program's Joint Program Manager.

RESPONSE: Partially concur. While the Services should designate a lead liaison officer to work with the STARS Program Manager, in this decreasing budget and manpower era, other solutions need to be found. As stated above the Services' current role is to prepare for the transition and exploitation of STARS products. When the Services' effort increases to require full-time liaison with the STARS Program, DARPA should negotiate with the Services to have their representatives be collocated with the STARS Program Office.

Corrective action has been initiated. Completion is expected by the end of FY 1991.

c. Evaluate the progress of the Software Technology for Adaptable, Reliable Systems annually to determine whether to continue the Program.

RESPONSE: Partially concur. We fully concur with the intent of this recommendation but think that the Program is currently being adequately reviewed and managed within DARPA and its Information Sciences and Technology Office. The changes in management structure and personnel were made to accomplish the management improvements now in place. DARPA will thoroughly review the STARS program annually to determine whether continuation is appropriate. No new action is planned.

d. Consolidate the management of technical activities of the Ada Joint Program Office, the Software Engineering Institute, and the Software Technology for Adaptable, Reliable Systems Joint Program Office.

RESPONSE: Do not concur. The management of the Software Engineering Institute (SEI) and the STARS Program have been consolidated for several years. The Ada Joint Program Office's primary activity is updating the Ada Standard in accordance with the requirements of the American National Standards Institute (ANSI) and the International Standards Organization (ISO). The technical efforts in the program are actually being managed within the Services, and are not closely related to either STARS or the SEI programs. There is already adequate technical coordination between the two programs through several mechanisms.

2. We recommend that the Director, Defense Advanced Research Projects Agency:

a. Require that the Software Technology for Adaptable, Reliable Systems Program to:

(1) establish quantitative program goals,

(2) document a performance baseline, and

(3) select and implement a system for measuring progress in goal achievement.

RESPONSE: Partially concur. Quantitative goals would be artificial, and therefore, not meaningful for STARS. However, The STARS Program Director is conducting a consolidated planning effort to establish a performance baseline, clear goals for each technical area, and an evaluation framework for measuring progress in their achievement. The SEI has been tasked to lead a team to develop the framework. They will evaluate the success of STARS technology in application demonstrations to be conducted in the FY94-95 timeframe.

Corrective action has been initiated. Completion is expected by the end of FY 1991.

b. Require that the Joint Program Manager develop, document, and maintain an effective system of management control objectives, requirements, and procedures unique to the Software Technology for Adaptable, Reliable Systems Program and incorporate them into the revised Program Management Plan.

RESPONSE: Concur. DARPA is revising the STARS Program Management Plan (PMP), and has already produced the first draft. The PMP will reflect the oganizational, financial, and program execution changes since 1986. The Plan will also incorporate the appropriate information to support fulfillment of this recommendation.

Corrective action has been initiated. Completion is expected by the end of FY 1991.

c. Designate the Software Technology for Adaptable, Reliable Systems Program as a major program and manage it accordingly.

RESPONSE: Concur. DARPA will designate STARS as a major program to be managed in accordance with DARPA Instruction No. 13. The revised PMP will serve as the detailed program plan required by Instruction No. 13. DARPA will ensure that the STARS Program receives appropriate review, both internally and externally, to provide necessary monitoring and evaluation of program progress, status and potential risks.

Corrective action has been initiated. Completion is expected by the end of FY 1991.

d. Develop and implement procedures to consistently identify major programs as defined in Defense Advanced Research Projects Agency Instruction No. 13.

RESPONSE: Concur. DARPA was already examining its structure, management systems, and procedures with respect to DoD's Total Quality Management (TQM) philosophy. Instruction 13 will be reviewed and updated as part of DARPA's current TQM effort to ensure procedures are in place to consistently identify major programs.

Corrective action has been initiated. Completion is expected by the end of FY 1991.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
1400 WILSON BOULEVARD
ARLINGTON, VA 22209-2308

NOV 13 1990

MEMORANDUM FOR THE INSPECTOR GENERAL, DEPARTMENT OF DEFENSE

SUBJECT: Draft Report on the inspection of the Software Technology for Adaptable, Reliable Systems (STARS) Program (Project No. OFE-0007)

In response to your memorandum of August 31, 1990, enclosed are comments to the draft report recommendations. Only those recommendations addressed to the Defense Advanced Research Projects Agency have been included.

While the response format deals only with the specific recommendations, an effort has been made to integrate our understanding of the report's issues and general discussion sections.

In all areas, remedies are already underway. Since the audit, the STARS Program has made progress in addressing the acknowledged deficiencies. Any further discussions which might be of benefit to ongoing and future changes are welcomed and encouraged. The point of contact is Dr. Jack Kramer at (703) 243-8655.

Victor H. Reis
Acting Director

Attachment:
Response

Responses to Recommendations
of the Inspector General, Department of Defense, Draft Report on the
Audit of Management of the Software Technology for Adaptable, Reliable Systems
(STARS) Program (Project No. OFE-0007) Conducted October 1989 through June 1990

Recommendation 1: Addressed to the Under Secretary of Defense (Acquisition).

Recommendation 2a: The Director, Defense Advanced Research Projects Agency require the Software Technology for Adaptable, Reliable Systems Program to:

(1) establish quantitative program goals,
(2) document a performance baseline, and
(3) select and implement a system for measuring progress in goal achievement.

Response: Partially concur. Quantitative goals would be artificial, and therefore, not meaningful for STARS. However, the STARS Program Director is conducting a consolidated planning effort to establish a performance baseline, clear goals for each technical area, and an evaluation framework for measuring progress in their achievement. The SEI has been tasked to lead a team to develop the framework. They will evaluate the success of STARS technology in application demonstrations to be conducted in FY94-95 timeframe.

Corrective action has been initiated. Completion expected during FY 1991.

Recommendation 2b: The Director, Defense Advanced Research Projects Agency, requires that the Joint Program Manager develop, document, and maintain an effective system of management control objectives, requirements, and procedures unique to the Software Technology for Adaptable, Reliable Systems Program and incorporate them into the revised Program Management Plan.

Response: Concur. DARPA is revising the STARS Program Management Plan (PMP), and has already produced the first draft. The PMP will reflect the organizational, financial, and program execution changes since 1986. The Plan will also incorporate the appropriate information to support fulfillment of this recommendation.

Corrective action has been initiated. Completion expected during FY 1991.

Recommendation 2c: The Director, Defense Advanced Research Projects Agency, designate the Software Technology for Adaptable Reliable Systems Program as a major program and manage it accordingly.

Response: Concur. DARPA will designate STARS as a major program to be managed in accordance with DARPA Instruction No. 13. The revised PMP will serve as the detailed program plan required by Instruction No. 13. DARPA will ensure that the STARS Program receives appropriate review, both internally and externally, to provide necessary monitoring and evaluation of program progress, status and potential risks.

Corrective action has been initiated. Completion is expected during FY 1991.

Recommendation 2d: The Director, Defense Advanced Research Projects Agency, develop and implement procedures to consistently identify major programs as defined in Defense Advanced Research Projects Agency Instruction No. 13.

Response: Concur. DARPA was already examining its structure, management systems, and procedures with respect to DoD's Total Quality Management (TQM) philosophy. Instruction 13 will be reviewed and updated as part of DARPA's current TQM effort to ensure procedures are in place to consistently identify major programs.

Corrective action has been initiated. Completion expected during FY 1991.

OFFICE OF THE COMPTROLLER OF THE DEPARTMENT OF DEFENSE

WASHINGTON, DC 20301-1100

NOV 5 1990

(Information Resources
Management)

MEMORANDUM FOR DEPUTY ASSISTANT INSPECTOR GENERAL FOR INSPECTION
GAO AND AUDIT FOLLOWUP

SUBJECT: OIG Report, "Draft Report on the Audit of Management of the Software Technology for Adaptable, Reliable Systems (STARS) Program (Project No. OFE-0007)."

In your August 31, 1990 memorandum, you requested we provide comments on the "Draft Report on the Audit of Management of the Software Technology for Adaptable, Reliable Systems (STARS) Program (Project No. OFE-0007)." The subject report has been reviewed and we concur with the reports recommendations. Additionally, before funding is approved, the Director of DARPA should be required to ensure that STARS research projects do not duplicate other research projects.

The Office of the Deputy Comptroller action officer is Mr. Burt Newlin at 695-2554.

C Kendall

Cynthia Kendall
Deputy Comptroller (Information
Resources Management)

SUMMARY OF POTENTIAL MONETARY AND OTHER BENEFITS RESULTING FROM AUDIT

Recommendation Reference	Category and Description of Benefit	Amount and/or Type of Benefit
1.a.	Program. Products of STARS made available in a timely manner.	Undeterminable monetary benefit. Savings cannot be determined until results of STARS are actually used.
1.b.	Economy and Efficiency. Enhanced Service involvement, better coordination with related software research by Services.	Nonmonetary. More efficient and effective management of STARS.
1.c.	Economy and Efficiency. DoD decision on best use of funds budgeted for STARS.	Undeterminable monetary benefit. Savings are unknown unless Program is completed or terminated.
1.d.	Economy and Efficiency. Centralized management of related DoD Software Initiative technical projects.	Nonmonetary. More effective use of DoD software research resources.
2.a.	Program. Clear indicators of STARS progress.	Nonmonetary. Improved ability to judge STARS' effectiveness and likely economic worth.
2.b.	Internal Control. More effective managerial control over STARS resources.	Nonmonetary. Establishment and documentation of STARS management control objectives and procedures.
2.c.	Compliance with DARPA Instruction No. 13.	Nonmonetary. More stringent DARPA oversight and detailed planning by STARS program managers.
2.d.	Internal Control. Provide for the uniform application of DARPA Instruction No. 13.	Nonmonetary. Consistent management of DARPA programs.

ACTIVITIES VISITED OR CONTACTED

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition, Washington, DC
Comptroller of the Department of Defense, Washington, DC
Director of Defense Research and Engineering, Washington, DC

Department of the Army

Director of Information Systems for Command, Control, Communications and Computers, Washington, DC

Department of the Navy

Space and Naval Warfare Systems Command, Washington, DC

Department of the Air Force

Air Force Systems Command, Andrews Air Force Base, MD
Electronic Systems Division, Hanscom Air Force Base, MA

Defense Agencies

Defense Advanced Research Projects Agency, Arlington, VA
Defense Contract Audit Agency, Alexandria, VA

Non-DoD Activities

National Aeronautics and Space Administration, Greenbelt, MD

Non-Government Activities

Boeing Aerospace and Electronics, Kent, WA
International Business Machines, Gaithersburg, MD
Software Engineering Institute, Pittsburgh, PA
Unisys, Reston, VA

AUDIT TEAM MEMBERS

Nancy L. Butler, Director for Financial Management Programs
Terry L. McKinney, Program Director
James W. Hutchinson, Project Manager
James F. Friel, Auditor
Frederick C. Sacchet, Auditor
Susanne B. Allen, Editor

FINAL REPORT DISTRIBUTION

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Department of the Navy

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Assistant Secretary of the Navy (Financial Management)

Department of the Air Force

Secretary of the Air Force
Assistant Secretary of the Air Force (Financial Management and Comptroller)

Defense Agencies

Director, Defense Advanced Research Projects Agency

Non-DoD Activities

Office of Management and Budget
U.S. General Accounting Office, NSIAD Technical Information Center

Congressional Committees:

Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
Senate Ranking Minority Member, Committee on Armed Services
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
House Ranking Minority Member, Committee on Appropriations
House Committee on Armed Services
House Subcommittee on Government Operations
House Subcommittee on Legislation and National Security, Committee on Government Operations