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CUSTOMS SERVICE MODERNIZATION

Serious Management and Technical Weaknesses Must Be Corrected

GAO

**Accounting and Information
Management Division**

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February 26, 1999

The Honorable Ben Nighthorse Campbell
Chairman, Subcommittee on Treasury,
    General Government, and Civil Service
Committee on Appropriations
United States Senate

The Honorable Jim Kolbe
Chairman, Subcommittee on Treasury,
    Postal Service, and General Government
Committee on Appropriations
House of Representatives

This report responds to your requests that we review the U. S. Customs Service's management
of the Automated Commercial Environment (ACE), including whether Customs has adequately
justified ACE cost-effectiveness. Customs plans to spend over $1 billion on ACE, which is planned
to support modernized import processing. We found that Customs' is not managing ACE
effectively and it does not have a firm basis for concluding that ACE is cost-effective.
Accordingly, we are making recommendations to the Commissioner of Customs for
strengthening the management and technical weaknesses we identified.

We are sending copies of this report to the Secretary of the Treasury; Commissioner of
Customs; Director of the Office of Management and Budget; and Ranking Minority Members of
the Subcommittee on Treasury, General Government, and Civil Service of the Senate
Committee on Appropriations and the Subcommittee on Treasury, Postal Service, and General
Government of the House Committee on Appropriations. We are also sending copies of this
report to the Chairmen and Ranking Minority Members of the Senate Committee on Finance
and the House Committee on Ways and Means and to other congressional committees. We will
also make copies available to other interested parties upon request. If you have questions or
wish to discuss the issues in this report, please contact me at (202) 512-6240. Major contributors
to this report are listed in appendix V.

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Associate Director, Governmentwide
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Executive Summary

Purpose

The U.S. Customs Service plans to spend well over $1 billion to modernize its systems environment for certain core missions: facilitating international trade, enforcing laws governing the flow of goods across U.S. borders, and assessing and collecting about $22 billion annually on imported merchandise. The Clinger-Cohen Act of 1996, and related system and software engineering best practices, provide federal agencies with a framework for effectively managing such modernization efforts.

The Customs modernization effort, known as the Automated Commercial Environment or ACE, is of longstanding concern to the House Appropriations Committee, Subcommittee on Treasury, Postal Service, and General Government, and the Senate Appropriations Committee, Subcommittee on Treasury, General Government, and Civil Service. Accordingly, the Subcommittee Chairmen asked GAO to determine whether Customs is effectively managing ACE, including whether Customs has adequately justified ACE cost-effectiveness.

Background

Title VI of the North American Free Trade Agreement Implementation Act, Public Law 103-182, enabled Customs to speed the processing of imports and improve compliance with trade laws. Customs refers to this legislation as the "Customs Modernization and Informed Compliance Act" or "Mod" Act. The primary purpose of the act is to streamline and automate Customs' commercial operations. According to Customs, modernized commercial operations will permit it to more efficiently handle its burgeoning import workloads and expedite the movement of merchandise at more than 300 ports of entry. For 1995 through 2001, Customs estimates that the annual dollar volume of import trade will increase from $761 billion to $1.1 trillion, with the number of commercial entries processed annually increasing from 13.1 million to 20.6 million.

ACE is Customs' system solution to a modernized commercial environment. In November 1997, Customs estimated that it would cost $1.05 billion to develop, operate, and maintain ACE over the 15 year period between fiscal year 1994 and 2008. Customs plans to develop and deploy ACE in multiple increments. The first four increments are known collectively as the National Customs Automation Program (NCAP). The first increment, NCAP 0.1, was deployed for field operation and evaluation in May 1998. As of the end of fiscal year 1998, Customs reported that it had spent $62.1 million on ACE.

Results in Brief

Customs is not managing ACE effectively, and it does not have a firm basis for concluding that ACE is a cost-effective solution to modernizing its commercial environment. GAO found serious weaknesses relating to architectural definition, investment management, and software development and acquisition that must be corrected before further investment in ACE is justified.

First, Customs is not building ACE within the context of a complete and enforced systems architecture or "construction plan" that precludes inconsistent system design and development decisions. In May 1998, GAO reported that Customs' architecture was incomplete because it was not based on a complete understanding of its enterprisewide functional and information needs. GAO also reported that Customs had not yet instituted effective procedures for ensuring compliance with the architecture once it is completed. Customs is attempting to complete its architecture, but it has not yet done so. Until its architecture is completed and effectively enforced, Customs will not have adequate assurance that information systems like ACE will optimally support its needs across all business areas.

Further, Customs lacks a reliable estimate of what ACE will cost to build, deploy, and maintain; and Customs has neither adequately justified, nor is it effectively monitoring, ACE's cost-effectiveness. Specifically, Customs did not use rigorous cost estimating techniques in preparing its cost estimate, and did not disclose the inherent imprecision of the estimate. Additionally, Customs omitted costs and inflated benefits in preparing its cost-benefit analysis. Moreover, Customs is not using effective incremental investment management practices. While Customs plans to develop/acquire ACE in 21 increments, these increments are not individually cost-benefit justified, and Customs is not determining what benefits each increment, once operational, actually provides. As a result, Customs will not know if ACE's expected return-on-investment is actually being realized until it has already spent hundreds of millions of dollars developing/acquiring the entire system. This combination of unreliable investment information and analysis, and a "grand design" approach to justifying and managing system investments,[1] has failed consistently on other agency modernization efforts over the past two decades, has been abandoned by successful organizations, and was a major reason for the information technology investment management reforms in the Clinger-Cohen Act of 1996.

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[1]The "grand design" approach involves investing in a large, long-term, expensive project based on cost and benefit estimates prepared at the outset and attempting to deliver the entire project years later as a single increment.

These investment risks and uncertainties are compounded by the fact that Customs is not employing effective software engineering practices on ACE. Specifically, Customs developed the first ACE increment in-house using its own software developers, but because of cost and schedule delays, it decided to acquire the second ACE increment from a software development contractor. GAO found that Customs has neither the capability to effectively develop nor acquire ACE and that its processes for doing both, according to widely accepted and proven software capability maturity models, are ad hoc, immature, and ineffective.

Principal Findings

Customs Is Developing ACE Without a Complete Enterprise Systems Architecture

The Clinger-Cohen Act recognizes the importance of architectures by requiring agency Chief Information Officers (CIO) to develop, maintain, and facilitate an integrated systems architecture. Customs does not have a complete target systems architecture. In May 1998, GAO reported that Customs' target systems architecture was not effective because it was neither complete nor enforced, and GAO made several recommendations for needed improvements.[2] For example, GAO reported that the architecture did not (1) fully describe Customs' business functions, (2) define the information needs and flows among these functions, and (3) establish the technical standards, products, and services that will be used to build systems that support these defined business functions and needs. GAO also reported that Customs did not require that its systems be architecturally compliant or that architectural deviations be justified and documented.

Customs officials acknowledged the limitations in the agency's architecture and its enforcement. They agreed to define functions, information needs, and flows across Customs' six business areas and, in light of this definition, reevaluate the technical characteristics the architecture specified for its system environment. Customs originally planned to have completed its target architecture by September 1998, but that date has slipped to May 1999. Since receiving a draft of this report, Customs has changed its investment management procedures with the intent of ensuring that its architecture, once completed, can be enforced effectively. Until its architecture is complete, however, Customs risks spending millions of dollars to develop, acquire, and maintain information

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[2]Customs Service Modernization: Architecture Must Be Complete and Enforced to Effectively Build and Maintain Systems (GAO/AIMD-98-70, May 1998).

systems, including ACE, that do not effectively and efficiently support the agency's mission needs.

ACE Investment Management Is Not Effective

The Clinger-Cohen Act and Office of Management and Budget (OMB) guidance provide an effective framework for information technology (IT) investment management. Together, they establish requirements for (1) identifying all promising alternative system solutions, (2) developing reliable estimates of project life-cycle costs and benefits, and investing in the most cost-beneficial alternative, and (3) to the maximum extent practical, structuring major projects into a series of increments to ensure that each increment constitutes a wise investment.

Customs did not consider potential alternatives, such as using the International Trade Data System (ITDS), to perform certain critical functions, before deciding to invest in ACE.[3] ITDS was initiated in 1995 as a project to implement the National Performance Review recommendation to develop a coordinated, governmentwide system for the collection, use, and dissemination of trade data. At that time, a multiagency board of directors was established, headed by the Department of the Treasury with Customs and other major trade-related agencies represented. The Department of the Treasury is responsible for designing and developing ITDS, which is expected to reduce the burden that federal agencies place on international organizations by requiring that they respond to duplicative data requests. Treasury intends for the system to serve as the single point for collecting, editing, and validating trade data as well as collecting and accounting for trade revenue—functions that are also planned for ACE.

Further, for the alternative it selected, i.e., ACE, Customs did not develop a reliable life-cycle cost estimate. Carnegie Mellon University's Software Engineering Institute (SEI) has developed criteria by which the reliability of project cost estimates can be assessed. Using SEI's criteria, GAO found that the processes used by Customs to develop its $1.05 billion ACE life-cycle cost estimate were neither thorough nor disciplined, and as a result, Customs' ACE cost estimate is not reliable and does not provide a sound basis for investment decision-making. For example, Customs did not use a cost model, did not account for changes in its approach to building different ACE increments, did not account for changes to ACE software and hardware architecture, and did not have the requisite

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[3]The U.S. Department of the Treasury has developed an ITDS project plan, system specification, cost-benefit analysis, and related documentation. It plans to begin developing ITDS in 1999 and to fully implement it by 2003. It estimates that ITDS will cost $256 million to develop, deploy, and maintain through 2005.

historical project cost data upon which to compare its ACE estimate. Additionally, the $1.05 billion cost estimate omits various relevant cost elements, such as requirements definition, data warehouse development, system documentation development, system integration, training, and hardware/software technology refreshment. Customs then exacerbated these problems by representing its ACE cost estimate as a precise, point estimate, rather than explicitly describing the estimate's inherent uncertainty to ensure that it would be used appropriately.

Moreover, Customs' projections of ACE benefits are overstated by at least $52.8 million. The analysis includes $203.5 million in savings attributable to 10 years of avoided maintenance and support costs on the Automated Commercial System (ACS)—the system that ACE is to replace. However, Customs will not avoid maintenance and support costs for 10 years. Because Customs plans to run both systems in parallel for 4 years, it will expend $52.8 million on continued maintenance and support of ACS during this period.

Lastly, although Customs has decided to implement ACE as a series of 21 increments, it is not making its investment decisions incrementally as required by the Clinger-Cohen Act and OMB. Specifically, Customs is not justifying investing in each increment on the basis of measurable benefits, and once it has deployed an increment at a pilot site for evaluation, it is not validating the benefits that the increment actually provides. Instead, Customs has estimated costs and benefits for the entire system (i.e., all 21 increments). Such estimates of many system increments to be delivered over many years are impossible to make accurately because later increments are not well understood or defined, and are subject to change in light of experiences on nearer term increments and changing business needs. By using an inaccurate, aggregated estimate that is not refined as increments are developed, Customs is committing enormous resources with no assurance that it will achieve a reasonable return on its investment. This "grand design" or "big bang" approach to managing large system modernization projects has repeatedly proven to be ineffective, resulting in huge sums invested in systems that do not provide expected benefits.

Customs Lacks the Capability to Develop or Acquire ACE Software Effectively

The Clinger-Cohen Act requires the establishment of effective IT management processes, including processes for managing software development and acquisition. SEI has developed criteria for determining organizations' software development and acquisition effectiveness or maturity.[4]

Using SEI criteria for process maturity at the "repeatable" level, which is the second level on SEI's five-level scale and means that an organization has the software development/acquisition rigor and discipline to repeat project successes, GAO evaluated ACE software processes. In February 1999, GAO reported that Customs lacked the capability to develop software effectively on several projects, including ACE.[5] For example, GAO reported that NCAP 0.1 lacked an effective software configuration management process, which is important for establishing and maintaining the integrity of the software products during development, and NCAP 0.1 did not have any type of software quality assurance program, which greatly increases the risk of ACE software not meeting process and product standards. GAO also reported that Customs lacked a software process improvement program to effectively address these and other software process weaknesses. Accordingly, GAO made several recommendations for needed improvements. Customs agreed with GAO's findings and stated that it initiated steps to implement GAO's recommendations, including assigning responsibility for software process improvement.

Additionally, GAO found that Customs lacks the capability to acquire ACE software effectively. For example, Customs did not have an effective software acquisition planning process, and therefore could not effectively establish reasonable plans for performing software engineering and for managing the software project. Also, Customs did not have an effective evaluation process, which means that it lacked the means for assuring that contractor-developed software satisfied defined requirements.

Because of these and other serious software process weaknesses, Customs' ability to either develop or acquire ACE software is immature, and therefore project success is unlikely.

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[4]Software Development Capability Maturity Model[SM] (SW-CMM®) and Software Acquisition Capability Maturity Model[SM] (SA-CMM®). Capability Maturity Model[SM] is a service mark of Carnegie Mellon University, and CMM® is registered in the U.S. Patent and Trademark Office.

[5]Customs Service Modernization: Immature Software Development Processes Increase Customs System Development Risks (GAO/AIMD-99-35, February 11, 1999).
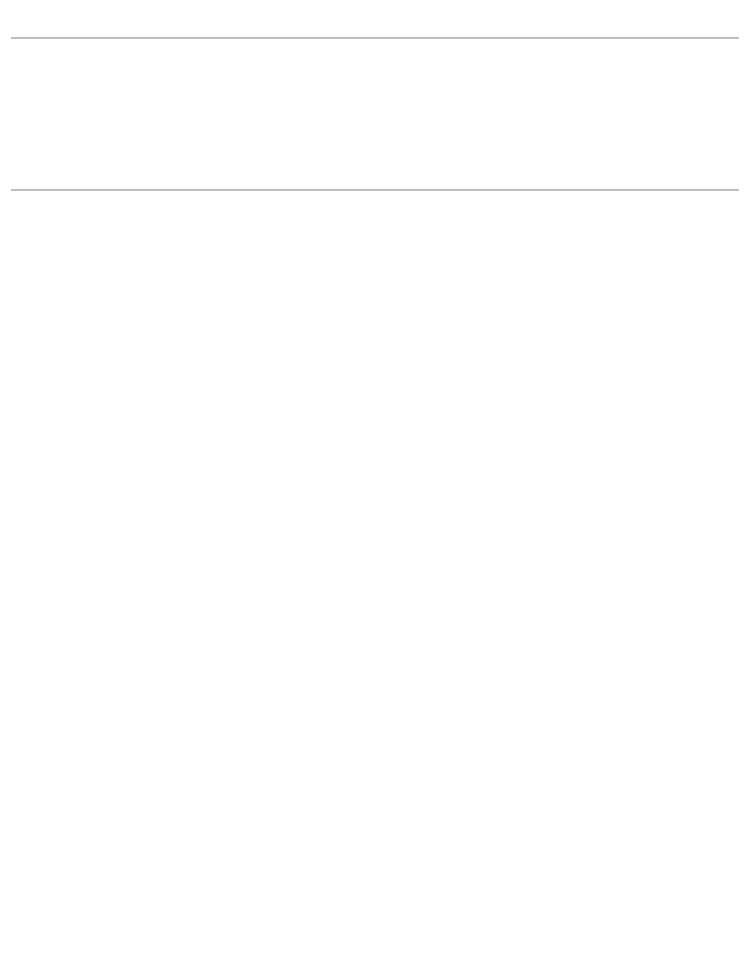
Recommendations

In addition to previous recommendations to improve Customs' management of information technology,L[6] GAO recommends that Customs correct the management and technical weaknesses discussed in this report before building ACE. To accomplish this, GAO recommends that the Commissioner of Customs, with the support of Customs' CIO, ensure that Customs

(1) rigorously analyze alternative approaches to building ACE, including ITDS as an alternative to developing ACE entirely within Customs;

(2) make investment decisions incrementally, i.e., for each increment:

- use disciplined processes to prepare a rigorous life-cycle cost estimate, including an explicit discussion of its inherent uncertainty;
- prepare realistic and supportable benefit expectations;
- require a favorable return-on-investment and compliance with Customs' architecture before making any investment; and
- validate actual costs and benefits once an increment is piloted, compare these with estimates, use the results in making further decisions on subsequent increments, and report the results to Customs' House and Senate appropriations and authorizing committees; and

(3) strengthen ACE software acquisition management by:

- establishing an effective process improvement program and correcting the weaknesses in ACE software acquisition processes identified in this report, thereby bringing ACE processes to at least SEI level 2 and
- requiring at least SEI level 2 processes of all ACE software contractors.

Agency Comments

In its written comments on a draft of this report, Customs agreed with GAO's conclusions and recommendations and stated that it is committed to addressing the problems discussed in the report. To this end, Customs cited a number of actions that it has underway and planned over the next few years to improve management of information technology in general, and ACE in specific. To fully correct the management and technical weaknesses discussed in this report, Customs must follow through and effectively implement actions to address all of GAO's recommendations. Customs' comments are discussed in greater detail in chapter 5 and the full text of its comments are reproduced in appendix I of this report.

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[6]GAO/AIMD-99-35, February 11, 1999 and GAO/AIMD-98-70, May 5, 1998.

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Abbreviations

ACE	Automated Commercial Environment
ACS	Automated Commercial System
CIO	chief information officer
CMM®	Capability Maturity Model[SM]
IRB	Investment Review Board
IT	information technology
ITDS	International Trade Data System
KPA	key process area
NAFTA	North American Free Trade Agreement
NCAP	National Customs Automation Program
OMB	Office of Management and Budget
SA-CMM®	Software Acquisition Capability Maturity Model[SM]
SCE	software capability evaluation
SEI	Software Engineering Institute
SW-CMM®	Software Development Capability Maturity Model[SM]

Introduction

The mission of the Customs Service is to ensure that all goods and persons entering and exiting the United States do so in compliance with all U.S. laws and regulations. It does this by (1) enforcing the laws governing the flow of goods and persons across U.S. borders and (2) assessing and collecting duties, taxes, and fees on imported merchandise. During fiscal year 1997, Customs collected $22.1 billion in revenue[1] at more than 300 ports of entry, and it processed nearly 450 million passengers entering the United States.

Customs' Core Business Operations: A Brief Description

To accomplish its mission, Customs is organized into the following six business areas: trade compliance, outbound, passenger, finance, human resources, and investigations. Each business area is described below.

- Trade compliance includes enforcement of laws and regulations associated with the importation of goods into the United States. To do so, Customs (1) works with the trade community to promote understanding of applicable laws and regulations, (2) selectively examines cargo to ensure that only eligible goods enter the country, (3) reviews documentation associated with cargo entries to ensure that they are properly valued and classified, (4) collects billions of dollars annually in duties, taxes, and fees associated with imported cargo, (5) assesses fines and penalties for noncompliance with trade laws and regulation, (6) seizes and accounts for illegal cargo, and (7) manages the collection of these moneys to ensure that all trade-related debts due to Customs are paid and properly accounted for.
- Outbound includes Customs enforcement of laws and regulations associated with the movement of merchandise and conveyances from the United States. To do so, Customs (1) selectively inspects cargo at U.S. ports to guard against the exportation of illegal goods, such as protected technologies, stolen vehicles, and illegal currency, (2) collects, disseminates, and uses intelligence to identify high-risk cargo and passengers, (3) assesses and collects fines and penalties associated with the exportation of illegal cargo, and (4) physically examines baggage and cargo at airport facilities for explosive and nuclear materials. In addition, the outbound business includes collecting and disseminating trade data within the federal government. Accurate trade data are crucial to establishing accurate trade statistics on which to base trade policy decisions and negotiate trade agreements with other countries. By the year 2000, Customs estimates that exports will be valued at $1.2 trillion, as compared to a reported $696 billion in 1994.

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[1]Includes tariff duty, user fees, Internal Revenue Service excise taxes, and other assessments.

- Passenger includes processing all passengers and crew of arriving and departing air, sea, and land conveyances and pedestrians. In fiscal year 1997, Customs reported that it processed nearly 450 million travelers, and by the year 2000, expects almost 500 million passengers to arrive in the United States annually. Many of Customs' passenger activities are coordinated with other federal agencies, such as the Immigration and Naturalization Service and the Department of Agriculture's Animal and Plant Health Inspection Service. Activities include targeting high-risk passengers, which requires timely and accurate information, and physically inspecting selected passengers, baggage, and vehicles to determine compliance with laws and regulations.
- Finance includes asset and revenue management activities. Asset management consists of activities to (1) formulate Customs' budget, (2) properly allocate and distribute funds, and (3) acquire, manage, and account for personnel, goods, and services. Revenue management encompasses all Customs activities to identify and establish amounts owed Customs, collect these amounts, and accurately report the status of revenue from all sources. Sources of revenue include duties, fees, taxes, other user fees, and forfeited currency and property. The revenue management activities interrelate closely with the revenue collection activities in the trade compliance, outbound, and passenger business areas.
- Human resources is responsible for filling positions, providing employee benefits and services, training employees, facilitating workforce effectiveness, and processing personnel actions for Customs' 18,000 employees and managers.
- Investigations includes activities to detect and eliminate narcotics and money laundering operations. Customs works with other agencies and foreign governments to reduce drug-related activity by interdicting (seizing and destroying) narcotics, investigating organizations involved in drug smuggling, and deterring smuggling efforts through various other methods. Customs also develops and provides information to the trade and carrier communities to assist them in their efforts to prevent smuggling organizations from using cargo containers and commercial conveyances to introduce narcotics into the United States.

To carry out its responsibilities, Customs relies on information systems and processes to assist its staff in (1) documenting, inspecting, and accounting for the movement and disposition of imported goods and (2) collecting and accounting for the related revenues. Customs expects its reliance on information systems to increase as a result of its burgeoning workload. For 1995 through 2001, Customs estimates that the annual

volume of import trade between the United States and other countries will increase from $761 billion to $1.1 trillion. This will result in Customs processing an estimated increase of 7.5 million import entries—from 13.1 million to 20.6 million annually—during the same period. Recent trade agreements, such as the North American Free Trade Agreement (NAFTA), have also increased the number and complexity of trade provisions that Customs must enforce.

Customs Is Legislatively Mandated to Modernize Operations and Systems

Both Customs and the Congress recognize that the ability to process the growing volume of imports while improving compliance with trade laws depends heavily on successfully modernizing Customs' trade compliance process and its supporting automated systems. To speed the processing of imports and improve compliance with trade laws, the Congress enacted Title VI of the North American Free Trade Agreement Implementation Act in December 1993.[2] Customs refers to this legislation as the "Customs Modernization and Informed Compliance Act" or "Mod" Act.

The primary purpose of the act is to streamline and automate Customs' commercial operations by eliminating certain legislatively mandated paper requirements and requiring Customs to establish the National Customs Automation Program (NCAP). The legislation also specified certain functions that NCAP must provide, including giving members of the trade community the capability to electronically file import entries at remote locations as well as enabling Customs to electronically process "drawback" claims, which are refunds of duties and taxes paid on imported goods that are subsequently exported or destroyed. According to Customs, the act provides the legal framework to automate commercial operations and thereby streamline the processing, and expedite the movement of merchandise at more than 300 ports of entry.

ACE Purpose, Plans, and Status

ACE is intended to support the trade compliance business process, implement Mod Act requirements, and replace the existing import system, the Automated Commercial System (ACS). ACS is nearly 15 years old and Customs reports that it is becoming increasingly difficult and expensive to operate, maintain, and enhance due to the system's antiquated hardware and software and limited processing capacity.

Currently, ACE's architecture is to include both (1) mainframe-based, centralized processing to support high-volume, repetitive transactions and

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[2]Public Law 103-182, 19 U.S.C. 1411 et seq.

(2) distributed, client-server processing and desktop PC interfaces to support port office analysis and decision support needs. The transaction-intensive applications are to run on IBM mainframes at Customs' national data center and are to be written in COBOL and C++. The distributed processing is to occur on UNIX servers and the applications are to be written in C++ and Java. To support this processing environment, Customs plans to design and implement a single, integrated agencywide database. It also plans to connect port offices to the national data center through existing communications networks comprising the Treasury Communications System, and to connect the trade community to the data center through the Internet and a combination of dial-up lines and dedicated lines.

According to Customs, ACE will facilitate increased compliance of individuals, businesses, and governments with the trade laws and regulations of the United States and increased communication with the trade community. It will also provide an integrated, account-based, automated information system for collecting, disseminating, and analyzing trade-related data and ensuring the proper collection and allocation of revenues.

Customs began developing ACE in 1994 and plans to develop and deploy ACE in 21 increments from 1998 through 2005. Each increment consists of the software and hardware necessary to perform a discrete portion of the total ACE functionality. The first four increments, known collectively as the NCAP prototype, will process pre-identified merchandise shipped into the U.S. via truck by three selected importers.[3] The first two increments, NCAP 0.1 and NCAP 0.2, were deployed for operational evaluation at three pilot border port locations (Detroit, Michigan; Laredo, Texas; and Port Huron, Michigan) during May 1998 and October 1998, respectively.

The succeeding 17 increments are intended to build upon the foundational capabilities contained within the four NCAP prototype increments, providing additional functionality including the capability to (1) process merchandise imported via rail, air, sea, and couriers, (2) process collections and refunds associated with imported cargo, (3) process warehouse entry cargo, and (4) process cargo subject to drawbacks. Until all of these deployments are completed, Customs intends to operate and maintain ACS.

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[3]The importers participating in the NCAP prototype are General Motors Corporation, Ford Motor Company, and Chrysler Corporation.

Customs' estimate of ACE costs has escalated since August 1997, when it initially estimated that ACE's 10-year life-cycle cost would be $895 million for the period 1998 through 2007. In November 1997, Customs revised this 10-year cost estimate to $987.6 million and also estimated that, over 15 years, from 1994 through 2008, it would spend $1.05 billion on ACE. It then used the $1.05 billion estimate along with estimated expected savings of $1.9 billion to justify ACE. Customs is currently reevaluating this estimate.

Figure 1.1 compares planned and actual deployments of the NCAP increments. As the figure illustrates, Customs is well over 2 years behind its original schedule for NCAP.

Figure 1.1: Planned Versus Actual NCAP Deployment Schedules

Original NCAP Dates

First Revised Dates

Second Revised Dates

Current / Actual Dates

Note: NCAP 0.3 and NCAP 0.4 current dates are unknown pending budget approval.

Objectives, Scope, and Methodology

The Chairman, Subcommittee on Treasury, Postal Service, and General Government, House Committee on Appropriations, and the Chairman,

Subcommittee on Treasury, General Government, and Civil Service, Senate Appropriations Committee, requested that we review ACE. Our objective was to determine whether Customs is effectively managing ACE, including whether Customs has adequately justified ACE cost-effectiveness. In making these determinations, we relied primarily on the following criteria: (1) the Clinger-Cohen Act of 1996[4] and other legislative reforms that require federal agencies to develop and maintain integrated systems architectures and improve their information technology investment management processes, (2) Office of Management and Budget guidance related to the acquisition and management of information resources, (3) GAO and Treasury systems architecture guidance, and (4) related Software Engineering Institute system engineering standards concerning cost estimating and software development and acquisition maturity.

To address our objective, we reviewed pertinent documentation (e.g., ACE project plan, system/software development process practices/standards, ACE technical architecture descriptions, and ACE project status reports) and interviewed responsible Treasury officials and Customs ACE project officials in order to identify (1) Customs' management structure for developing and deploying ACE, (2) the ACE system/software development methodology, (3) the planned ACE hardware/software and communications architecture and configuration, and (4) the current ACE system development status.

Additionally, we met with Customs ACE officials to determine the status of the agency's implementation of recommendations we made in May 1998 to complete its systems architecture. These recommendations included (1) ensuring that the architecture fully described Customs' business functions, (2) defining the information needs and flows among these functions, (3) establishing the technical standards, products, and services that will be used to build systems that support these business functions and needs, and (4) enforcing compliance with the architecture.

Further, we obtained and reviewed supporting documentation and interviewed Treasury officials, Customs ACE officials, and Customs Investment Review Board (IRB) officials to (1) identify the current ACE

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[4]Although the Clinger-Cohen Act (Public Law 104-106) was passed after Customs began developing ACE, its principles are based on practices that are widely considered to be integral to successful IT investments. For an analysis of the management practices of several leading private and public sector organizations on which the Clinger-Cohen Act is based see Executive Guide: Improving Mission Performance Through Strategic Information Management and Technology, (GAO/AIMD-94-115, May 1994). For an overview of the IT management process envisioned by Clinger-Cohen see Assessing Risk and Returns: A Guide for Evaluating Federal Agencies' IT Investment Decision-making (GAO/AIMD-10.1.13, February 1997).

project cost and life-cycle cost estimate baselines and determine the current actual expenditures to date, (2) identify the current ACE project schedule baseline and determine the actual progress to date against scheduled milestones, (3) define what ACE is intended to do and how it is expected to benefit Customs' mission, (4) determine the extent to which ACE mission-related goals/benefits have been achieved to date and how Customs is measuring the accrued benefits, and (5) determine Customs' strategic approach to managing the development/acquisition, integration, and deployment of ACE. The documentation we analyzed included the ACE project plan and strategic plan, functional/performance requirements, and NCAP technical assessment documents, budget/financial data, cost-benefit policy and guidance, cost-benefit analyses, various life-cycle and project cost estimates, project status reports, testing problem reports, and configuration management documentation.

Also, we reviewed project documentation to determine how the life-cycle cost baseline was estimated and how this estimating approach compared to criteria established by SEI in A Manager's Checklist for Validating Software Cost and Schedule Estimates.[5] The SEI criteria defines seven primary questions, each supported by more detailed secondary questions, that can be used to determine whether defined and disciplined processes were used to derive a given cost estimate. We also interviewed ACE project officials.

In addition, we assessed whether Customs thoroughly analyzed technical alternatives to ACE including the possibility of (1) enhancing and continuing to use the legacy trade system, ACS, (2) using different architectural designs for ACE, (3) following different development/acquisition strategies, and/or (4) using the Department of the Treasury's planned multiagency International Trade Data System (ITDS), instead of ACE, for some functions, such as collecting, editing, and validating trade data and collecting and accounting for trade revenue.

Last, we used the Software Engineering Institute's (SEI's) Software Development Capability Maturity Model[SM] (SW-CMM®),[6] Software Acquisition Capability Maturity Model[SM] (SA-CMM®), and its Software Capability Evaluation Method, to evaluate Customs' ability to manage its NCAP 0.1 software development project and NCAP 0.2 software acquisition effort, respectively. These models and methods provide a logical and

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[5]CMU/SEI-95-SR-004, January 1995.

[6]Capability Maturity Model[SM] is a service mark of Carnegie Mellon University, and CMM® is registered in the U.S. Patent and Trademark Office.

widely accepted framework for baselining an organization's current process capabilities (i.e., strengths and weaknesses) and assessing whether an organization has the necessary process discipline in place to repeat earlier successes on similar projects. Organizations that do not satisfy the requirements for the "repeatable" level are by default judged to be at the "initial" level of maturity, meaning that their processes are ad hoc, sometimes even chaotic, with few of the processes defined and success dependent mainly on the heroic efforts of individuals.

In following the SEI method, GAO staff trained at SEI evaluated Customs' ACE project software development/maintenance maturity in five of the six key process areas (KPA) that are necessary to attain a "repeatable" level of process maturity.[7] GAO did not evaluate Customs in the sixth repeatable level KPA, software subcontract management, because Customs did not use subcontractors on the ACE project. Additionally, GAO staff trained at SEI evaluated Customs' ACE project software acquisition maturity in the seven KPAs that are necessary to attain a repeatable level of process capability, and one KPA associated with the "defined" level of process maturity—acquisition risk management.[8] The purpose of acquisition risk management is to formally identify risks as early as possible and adjust the acquisition to mitigate those risks. Many software experts consider acquisition risk management to be an integral part of the solicitation,

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[7]The five KPAs are requirements management, software project planning, software project tracking and oversight, software quality assurance, and software configuration management. According to the SW-CMM, (1) requirements management is the process of establishing a common understanding between the customer and the software developer of the customer's requirements, (2) software project planning is the process of establishing reasonable plans for engineering the software and managing the software project, (3) software project tracking and oversight is the process of providing adequate visibility into the software project's progress to permit effective action when deviations from plans occur, (4) software quality assurance is the process of verifying for management that software process and product procedures and standards are being followed, and (5) software configuration management is the process of establishing and maintaining the integrity of the software products throughout their life-cycle.

[8]The seven KPA's relating to the repeatable level are software acquisition planning, solicitation, requirements development and management, project office management, contract tracking and oversight, evaluation, and transition and support. The KPA relating to the defined level is acquisition risk management. According to the SA-CMM, (1) software acquisition planning is the process of ensuring that reasonable planning for all elements of the software acquisition occur, (2) solicitation is the process of ensuring that award is made to the contractor most capable of satisfying the specified requirements, (3) requirements development and management is the process of establishing an unambiguous and agreed upon set of software requirements, (4) project office management is the process of effective and efficient management of project office activities, (5) contract tracking and oversight is the process of ensuring that contractor activities, products, and services satisfy contract requirements, (6) evaluation is the process of determining that acquired software products and services satisfy contract requirements prior to acceptance, (7) transition and support is the process of transferring acquired software products to the eventual support organization, and (8) acquisition risk management is the process of identifying software risks early and adjusting the acquisition strategy to mitigate those risks.

project performance management, and contract performance management processes.

Customs provided written comments on a draft of this report. These comments are presented in chapter 5, and are reprinted in appendix I. We performed our work at Customs and Department of the Treasury headquarters offices in Washington, D.C., and at the Customs Data Center facility in Newington, Virginia between February 1998 and November 1998, in accordance with generally accepted government auditing standards.

ACE Is Being Developed Without a Complete Enterprise Systems Architecture

Architectures are critical for designing and developing large and complex information systems. These comprehensive "construction plans" systematically and completely describe an organization's target business environment, both in logical (e.g., missions, business functions, information flows) terms and technical (e.g., software, hardware, communications) terms. Without a target architecture to guide and constrain IT investment, there is no systematic way to preclude either inconsistent system design and development decisions or the resulting suboptimal performance and added cost associated with incompatible systems.

The Clinger-Cohen Act of 1996 requires agency CIOs to develop and maintain an integrated system architecture. In addition, OMB issued guidance in 1996 that, among other things, requires agency IT investments to be consistent with federal, agency, and bureau architectures.[1]

Customs does not currently have a complete target architecture but has recently established a process for enforcing an architecture once one is completed. Customs has plans for completing its target architecture by May 1999 and ensuring its enforcement. Thus far, however, it has only defined its current architectural environment.

A Framework for Effective Systems Architectures

Reflecting the general consensus in the industry that large, complex systems development and acquisition efforts should be guided by explicit architectures, we issued a report in 1992 defining a comprehensive framework for designing and developing systems architectures.[2] This framework, which is consistent with guidance that Treasury has provided to its bureaus,[3] divides systems architectures into (1) a logical or business component, which is developed first, and (2) a technical or systems component, which is based on the first component.

The logical component ensures that the systems meet the business needs of the organization. It provides a high-level description of the organization's mission and target concept of operations; the business functions being performed and the relationships among functions; the

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[1]OMB Memorandum M-97-02, Funding Information Systems Investments, October 25, 1996.

[2]Strategic Information Planning: Framework for Designing and Developing System Architectures (GAO/IMTEC-92-51, June 1992).

[3]This guidance—Treasury Information Systems Architecture Framework (TISAF) version 1.0, January 3, 1997—is also included in OMB's guidance on developing system architecture. See, OMB Memorandum M-97-16, Information Technology Architectures, June 18, 1997.

information needed to perform the functions; the users and locations of the functions and information; and the information systems needed to support the agency's business needs.

The technical component ensures that systems are interoperable, function together efficiently, and are cost-effective over their life-cycles (including maintenance costs). The technical component details specific standards and approaches that will be used to build systems, including hardware, software, communications, data management, security, and performance characteristics.

Customs Is Developing, but Has Not Yet Completed, Its Target Systems Architecture

Customs does not currently have a complete enterprise systems architecture. In May 1998, we reported that for five of its six business areas (outbound, passenger, finance, human resources, and investigations), Customs' architecture does not (1) describe all of the agency's business functions, (2) completely identify the users and locations of the functions, or (3) define the information needed to perform the functions.[4] Further, while the architecture and related documentation describe business functions and users and work locations for the sixth business area (trade compliance), they do not identify all of the information needs and flows for all of the trade functions. Nonetheless, Customs had defined many characteristics of its systems' hardware, software, communications, data management, and security components. Because these characteristics were not based on a complete understanding of its enterprisewide functional and information needs, as specified in both best practice and Treasury guidance, we concluded that Customs did not have adequate assurance that its information systems will optimally support its needs across all business areas.

We recommended that the Commissioner of Customs direct the Customs CIO, in consultation with the Treasury CIO, to complete the architecture. Specifically, we recommended that, at a minimum, the architecture should (1) describe Customs' target business operations, (2) fully define Customs' interrelated business functions to support these target operations, (3) clearly describe information needs and flows among these functions, (4) identify the systems that will provide these functions and support these information needs and flows, and (5) use this information to specify the technical standards and related characteristics that these systems should possess to ensure that they interoperate, function together efficiently, and are cost-effective to maintain.

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[4]GAO/AIMD-98-70, May 5, 1998.

Customs and Treasury officials have acknowledged the limitations in Customs' architecture, and agreed to define the agency's logical architecture (e.g., functions, information needs and flows and users) across its six business areas and, in light of this definition, reevaluate the technical characteristics it has specified for its technical architecture (i.e., systems environment). Thus far, Customs has defined its current (i.e., its "as-is" or "in-state") architectural environment, including its current business operations, its current supporting business functions and their information needs and flows, the systems currently supporting these functions, and the technical characteristics (e.g., hardware, software, and communications) of these supporting systems. However, Customs has not defined an architecture for its target (i.e., future) business and systems environment. Customs originally planned to have completed its target architecture by September 1998, but that date is now May 1999.

Customs Has Recently Announced Process for Ensuring Architectural Compliance

In May 1998, we reported that Customs' investment management process[5] did not ensure that all new systems would conform to the architecture. In particular, we reported that Customs' investment review board (IRB) used four criteria in scoring competing investment options and allocating funding among them. The four criteria were

(1) risk (e.g., technical, schedule, and cost);

(2) strategic alignment (e.g., cross-functional benefits, linkage to Customs' business plan, and compliance with legislative mandates);

(3) mission effectiveness (e.g., contributions to service delivery); and

(4) cost-benefit ratio (e.g., tangible and intangible benefits, and costs).

Because compliance with the architecture was considered under the risk criterion but was not required, the process did not preclude funding projects that were inconsistent with the enterprise architecture. Moreover, the process did not require that such deviations from the architecture be rigorously justified.

To ensure that Customs effectively enforced its information systems architecture, we recommended that Customs require that all new projects comply with the architecture unless an exception could be justified by

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[5]IT Investment Management Process, U.S. Customs Service, August 28, 1997.

careful, thorough, and documented analysis.[6] Customs agreed and, in January 1999, changed its investment management process to explicitly require that proposed IT investments comply with its architecture, unless an exception is justified and a waiver is granted by the technical review committee.

Conclusions

Until Customs completes and enforces its enterprise systems architecture, it will not have adequate assurance that ACE and other systems it plans to build and operationally deploy (1) will effectively meet the agency's business needs and (2) are compatible, efficient, and cost-effective to develop, integrate, and maintain.

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[6]GAO/AIMD-98-70, May 5, 1998.

Customs' ACE Investment Management Practices Are Ineffective

The Clinger-Cohen Act and OMB guidance provide an effective framework for IT investment management. Together, they set requirements for (1) identifying all potential alternative system solutions, (2) developing reliable estimates of project life-cycle costs and benefits, and investing in the most cost-beneficial alternative, and (3) to the maximum extent practical, structuring major projects into a series of increments to ensure that each increment constitutes a wise investment.

Customs has not effectively implemented any of these investment management practices on ACE. Specifically, (1) Customs' investment analysis did not address alternatives to its chosen ACE system solution, (2) Customs' did not use rigorous cost estimating techniques in preparing its ACE cost estimate and its cost-benefit analysis for ACE omitted substantial costs and inflated benefits, and (3) Customs is not justifying and validating the costs and benefits for each ACE increment. As a result, Customs lacks a sound basis for making ACE investment decisions.

ACE Alternatives Were Not Considered

Before embarking on a major, costly systems initiative such as ACE, agencies should thoroughly assess the full range of technical options. In the case of ACE, Customs had several alternatives to satisfying its mission needs as specified in the Mod Act. For example, it could enhance ACS, use different architectural designs for ACE, follow different development/acquisition strategies for ACE, and/or use Treasury's planned governmentwide trade system, International Trade Data System (ITDS), to supplement some ACE functions, such as collecting and disseminating trade data. ITDS was initiated in 1995 as a project to implement the National Performance Review recommendation to develop a coordinated, governmentwide system for the collection, use, and dissemination of trade data. At that time, a multiagency board of directors was established, headed by the Department of the Treasury with Customs and other major trade-related agencies represented. The Department of the Treasury is responsible for designing and developing ITDS, which is expected to reduce the burden that federal agencies place on the international trading organizations by requiring that they respond to duplicative data requests. Treasury intends for the system to serve as the single point for collecting, editing, and validating trade data as well as collecting and accounting for trade revenue.[1]

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[1]Treasury has developed an ITDS project plan, system specification, cost-benefit analysis, and related documentation. It plans to begin developing ITDS in 1999 and to fully implement it by 2003. It estimates that ITDS will cost $256 million to develop, deploy, and maintain through 2005.

By thoroughly considering these and other choices, Customs would have ensured that the most cost-effective and beneficial alternative was chosen before deciding to invest $1.05 billion in ACE. In fact, OMB requires that agencies consider alternative system solutions to meet mission needs, including different system architectures, upgrading existing systems, or contracting for development and integration of major systems.

Customs did not identify and evaluate a full range of alternatives to ACE. In fact, Customs considered only (1) enhancing and operating ACS to provide the same functionality of ACE, (2) operating ACS without any enhancement, (3) operating ACS with limited enhancements, and (4) developing and deploying part of ACE's planned functionality. Customs discarded the last three because none provided for meeting all of the Mod Act requirements. With respect to the first, Customs compared ACS to ACE and decided that ACE was the more cost-effective alternative.

Customs did not evaluate other alternatives to its ACE solution, including (1) adopting a different ACE architectural design (e.g., using a combination mainframe and client-server configuration instead of a mainframe only system), (2) contracting out for ACE development rather than developing ACE in-house, or (3) using ITDS to satisfy part of its functional needs. As a result, Customs committed to and began investing in ACE development without knowing whether it had chosen the most cost-effective alternative.

Since making its decision to develop ACE, Customs has changed ACE's architectural design, and it has decided to acquire the second ACE increment rather than develop it in-house. However, these decisions are not supported by any verifiable alternatives analysis, meaning that Customs still lacks adequate assurance that it is following the most cost-effective approach to satisfying its mission needs.

Customs' $1.05 Billion ACE Cost Estimate Is Not Reliable

Reliable estimates of IT projects' expected costs are essential to determining a project's cost-effectiveness. Without such information, the likelihood of poor investment decisions is increased, not only when a project is initiated but also throughout its life-cycle.

To assist management in assessing the credibility of a given project's cost estimate, SEI developed the following seven questions for decisionmakers

to use to assess the reliability of a project's cost estimate and detailed criteria to assist in evaluating how well a project satisfies each question.[2]

(1) Are the objectives of the estimate clear and correct?

(2) Has the task been appropriately sized?

(3) Is the estimated cost consistent with demonstrated accomplishments on other projects?

(4) Have the factors that affect the estimate been identified and explained?

(5) Have steps been taken to ensure the integrity of the estimating process?

(6) Is the organization's historical evidence capable of supporting a reliable estimate?

(7) Has the situation remained unchanged since the estimate was prepared?

We analyzed the approach that Customs followed in deriving its $1.05 billion ACE life-cycle cost estimate using SEI's criteria. Among these criteria were several very significant and closely intertwined requirements that are at the core of effective cost estimating. Specifically, embedded in several of the aforementioned seven questions are requirements for using (1) formal cost models, (2) structured and documented processes for determining the software size and reuse inputs to the models, and (3) relevant, measured, and normalized historical cost data (estimated and actual) to calibrate the models.[3]

We found that Customs did not satisfy any of these requirements. In particular, Customs did not use a cost model. Instead, it used an unsophisticated spreadsheet to extrapolate the cost of each ACE increment. Further, Customs' approach to determining software size and reuse was not documented and was not well supported or convincing. Customs estimated the size of each ACE software increment (most of which were still undefined) by extrapolating from the estimated size of the first

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[2]*A Manager's Checklist for Validating Software Cost and Schedule Estimates* (CMU/SEI-95-SR-004, January 1995).

[3]Examples of such data are the productivity value of a "staff-month," that is, the time and cost to produce a specified unit of code, such as a line of code.

increment based on individuals' undocumented best judgments about increment functionality and complexity. Last, Customs did not have any historical project cost data at the time it developed the $1.05 billion estimate, and it did not account for relevant, measured, and normalized differences among the increments. For example, it did not account for (1) the change in ACE's architecture from a mainframe system written in COBOL and C++ to a combined mainframe and Internet-based system written in C++ and Java and (2) the change in ACE from an in-house software development project (NCAP 0.1) to a software acquisition (NCAP 0.2). Clearly, such fundamental changes can have a dramatic effect on system costs, and should have been addressed explicitly in Customs' cost estimates.

Table 3.1 summarizes the complete results of our assessment of Customs' cost estimating process. For each of SEI's questions and supporting criteria, Customs was rated as demonstrating a strength, i.e., effectively implementing the criterion; a weakness, i.e., ineffectively implementing the criterion; or, where evidence was inconclusive and could not support characterization as either a strength or a weakness, an observation was noted. (See appendix II for further detail on SEI's criteria and our findings).

Table 3.1: Summary of ACE Project Cost Estimate's Satisfaction of SEI's Checklist Criteria

SEI checklist questions	Number of strengths	Number of weaknesses	Number of observations
Are the objectives of the estimate clear and correct?	4	0	0
Has the task been appropriately sized?	0	7	1
Is the estimated cost consistent with demonstrated accomplishments on other projects?	1	10	0
Have the factors that affect the estimate been identified and explained?	3	2	0
Have steps been taken to ensure the integrity of the estimating process?	3	1	3
Is the organization's historical evidence capable of supporting a reliable estimate?	2	8	0
Has the situation remained unchanged since the estimate was prepared?	0	3	0
Totals	**13**	**31**	**4**

Customs' Cost Estimate Implies an Unjustified Level of Precision

Software and systems development experts agree that early project estimates are by definition imprecise, and that this inherent imprecision decreases during the project's life-cycle as more information becomes known about the system. These experts emphasize that, to be useful, each cost estimate should include an indication of its degree of uncertainty, possibly as an estimated range or qualified by some factor of confidence. For example, a cost estimate of $1 million could be presented as a range from $750,000 to $1.25 million or as $1 million with a confidence level of 90 percent, indicating that there is a 10 percent chance that costs will exceed this estimate.

Customs did not reveal the degree of uncertainty of its cost estimate for ACE to managers involved in investment decisions. For example, Customs did not disclose that it made the estimate before fully defining ACE functionality. Instead, Customs presented its $1.05 billion ACE life-cycle cost estimate as an unqualified point estimate. This suggests an element of precision that cannot exist for such an undefined system and obscures the investment risk remaining in this project.

Customs' Analysis of ACE Costs and Benefits Is Also Unreliable

ACE cost estimates are understated, benefit estimates are overstated, and both are unreliable. Customs' August 1997 cost-benefit analysis estimated that ACE would produce cumulative savings of $1.9 billion over a 10-year life-cycle beginning in fiscal year 1998 and ending in fiscal year 2007. However, this analysis was unreliable because certain benefits and costs were unsupported, other benefits were overstated, and relevant costs were omitted. For example:

- The analysis identified $650 million (35 percent of the total ACE estimated savings) in savings to the trade community from more accurate and timely data, improved customer compliance, reduced support staff, reduced transportation costs, elimination of duplicate recordkeeping systems, and lower processing costs associated with periodic payments. However, Customs could not produce any verifiable data or analysis to support this claim. According to Customs officials, this benefit amount was projected on the basis of undocumented information supplied by one company. The officials stated that other companies considered such data confidential and would not provide them to Customs.
- The analysis identified an additional $644 million (33 percent of the total savings) resulting from increased productivity. Because this estimate is driven by Customs' assumption that *every* minute "saved" by processing transactions or analyzing data faster using ACE, rather than ACS, would be

productively used by *all* workers, it can be viewed as a "best case," upper limit on estimated productivity improvements. Given the magnitude of the potential savings, even a small change in the assumption translates into a large reduction in benefits. For example, conservatively assuming that three-fourths of each minute saved would be productively utilized by three-fourths of all workers, the expected benefits would be reduced by about $282 million.

- The analysis excluded costs for hardware and system software upgrades (e.g., desktop workstations and operating systems, application and data servers, data base management systems) at each port office. Using Customs' estimate for acquiring the initial suite of port office hardware and system software, and assuming a technology refreshment cycle of every 3 to 5 years, we estimated this cost to be between $72.9 million and $171.8 million.
- The analysis excluded $52.8 million of costs needed to support the data center and maintain ACS through fiscal year 2002. Since Customs intends to operate and maintain ACS in parallel with ACE through 2002, these costs should be included.
- The analysis excluded costs to conduct security analysis, project planning and management, and independent verification and validation. Customs estimates that these costs collectively total $23 million.
- The analysis excluded other relevant cost items, such as the cost of defining ACE requirements, integrating ACE components, and conducting ACE regression testing and training. Customs did not have an estimated value for these costs.
- The analysis included annual telecommunications costs of $60.3 million once ACE is deployed to all sites. However, Customs could not provide us with any supporting data or analysis for this estimate.

Customs Is Not Investing Incrementally in ACE

Incremental project management involves three fundamental components: (1) developing/acquiring a large system in a series of smaller projects or system increments, (2) individually justifying investment in each separate increment on the basis of return-on-investment, and (3) monitoring actual benefits achieved and costs incurred on completed increments and modifying subsequent increments/investments to reflect lessons learned. By doing so, agencies avoid discovering too late that their system is not cost-beneficial, and they can reduce the enormous risks associated with large, expensive projects. The Clinger-Cohen Act requires that agencies acquire information technology incrementally, to the maximum extent practicable, and have milestones for senior managers to obtain information on the cost, timeliness, quality, and capability of information

system investments to meet requirements. Additionally, OMB policy requires that investments in major information systems be implemented in increments with each increment delivering measureable benefits.[4]

Customs is developing and acquiring ACE in a series of 21 increments. It has, to date, defined the functionality of only the first two increments and will define later increments in the future. Nonetheless Customs has estimated costs and benefits for, and has committed to, investing in the entire system (i.e., all 21 increments). It has not estimated the costs and benefits for each increment and does not know whether each increment will produce a reasonable return on investment. Furthermore, once it has deployed an increment at a pilot site for evaluation, Customs is not validating that estimated benefits were actually achieved. As a result, Customs will not even know whether the first ACE increment, now being piloted at three sites, is producing expected benefits or is cost-effective. Instead, Customs will only determine whether the first increment is performing at a level "equal to or better than" ACS.

Customs "grand design" approach to ACE does not constitute wise investment management. Customs will not know whether earlier increments were cost beneficial before it invests in later increments; it does not have reliable cost or benefit data upon which to base investment decisions; and it is committing substantial resources with no assurance that it will achieve a reasonable return-on-investment.

Conclusions

Because Customs does not have reliable information on ACE costs and benefits and has not analyzed other viable alternatives to the system solution it selected, it does not have adequate assurance that ACE is the optimal approach. In fact, it has no assurance at all that ACE is cost effective. Furthermore, because it is not justifying the return on its investment in each ACE increment, Customs will not be able to demonstrate whether ACE is cost-effective until it has already spent hundreds of millions of dollars to develop/acquire the entire system.

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[4]Memorandum For Heads Of Executive Department And Agencies, October 25, 1996 (M-97-02).

ACE Software Development and Acquisition Processes Are Not Effective

The Clinger-Cohen Act requires agency CIOs to establish effective IT management processes, such as processes for developing or acquiring software. Customs has developed the first ACE software increment (NCAP 0.1) in-house and is acquiring the second increment (NCAP 0.2) from a contractor. Customs has not yet decided whether it will develop or acquire future ACE software increments. If it is to do either effectively, Customs must use mature software processes.

SEI, recognized for its expertise in software processes, has developed models and methods that define and determine, respectively, software development and software acquisition process maturity. We evaluated both ACE software development and ACE software acquisition processes using SEI's software development capability maturity model (SW-CMM) and software acquisition capability maturity model (SA-CMM), respectively, and SEI's software capability evaluation (SCE) method. Our evaluations focused on the key process areas (KPA) necessary to obtain a "repeatable" level of maturity, the second level of SEI's five-level process maturity models. Organizations that do not satisfy these second-level KPA requirements are by default at the "initial" or first level, meaning that their processes are ad hoc, sometimes even chaotic.

Our evaluations found that Customs lacks the capability to either develop or acquire ACE software effectively, and that it lacks a software process improvement program.[1] Because of the number and severity of the KPA weaknesses found, Customs did not achieve the "repeatable" level of process maturity as either a software developer or acquirer, meaning that any attempts to do so are likely to produce software that does not perform as intended, costs more than expected, and is delivered late. Further, without a software process improvement program, it is unlikely that Customs can effectively address its software process weaknesses.

SEI's Software Capability Models and Method: A Brief Description

The SW-CMM and the SA-CMM rank organizational maturity according to five levels. Maturity levels 2 through 5 require verifiable existence and use of certain key process areas, known as KPAs. The SW-CMM includes six level 2 KPAs. We evaluated Customs' against five of the six. The sixth level 2 KPA, software subcontract management, was not evaluated because Customs did not use subcontractors on NCAP 0.1 (see table 4.1 for a description of each KPA).

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[1]The results of our evaluation of ACE software development maturity and Customs' software process improvement efforts were first published in our report on Customs-wide software development capability (Customs Service Modernization: Immature Software Development Processes Increase Customs Systems Development Risks (GAO/AIMD-99-35, February 11, 1999)).

Table 4.1: Description of SW-CMM Level 2 KPAs

SW-CMM Level 2 KPAs	Description
Requirements management	Defining, validating, and prioritizing requirements, such as functions, performance, and delivery dates.
Software project planning	Developing estimates for the work to be performed, establishing the necessary commitments, and defining the plan to perform the work.
Software project tracking and oversight	Tracking and reviewing software accomplishments and results against documented estimates, commitments, and plans and adjusting these based on the actual accomplishments and results.
Software subcontract management	Selecting qualified contractors and managing them effectively.
Software quality assurance	Reviewing and auditing the software products and activities to ensure that they comply with the applicable processes, standards, and procedures and providing the staff and managers with the results of these reviews and audits.
Software configuration management	Selecting project baseline items, such as specifications, systematically controlling these items and changes to them, and recording and reporting status and change activity for these items.

The SA-CMM includes seven level 2 KPAs. We evaluated Customs against all seven level 2 KPAs. We also evaluated Customs against one level 3 KPA—acquisition risk management—because it is considered by software experts to be an integral part of the solicitation, project performance management, and contract performance management processes (see table 4.2 for a description of each KPA).

Table 4.2: Description of SA-CMM Level 2 KPA's and the Risk Management Level 3 KPA

SA-CMM Level 2 KPAs	Description
Software acquisition planning	Ensuring that reasonable planning for the software acquisition is conducted and that all elements of the project are included.
Solicitation	Ensuring that award is made to the contractor most capable of satisfying the specified requirements.
Requirements development and management	Establishing a common and unambiguous definition of software acquisition requirements understood by the acquisition team, system user, and the contractor.
Project office management	Managing the activities of the project office and supporting contractor(s) to ensure a timely, efficient, and effective software acquisition.
Contract tracking and oversight	Ensuring that the software activities under contract are being performed in accordance with contract requirements, and that products and services will satisfy contract requirements.
Evaluation	Determining that the acquired software products and services satisfy contract requirements prior to acceptance and transition to support.
Transition and support	Providing for the transition of the software products being acquired to their eventual support organization.
SA-CMM Level 3 KPA	**Description**
Acquisition risk management	Identifying risks as early as possible, adjusting acquisition strategy to mitigate those risks, and developing and implementing a risk management process as an integral part of the acquisition process.

For both models, each KPA contains five common attributes that indicate whether the implementation and institutionalization of a KPA can be effective, repeatable, and lasting. The five common features are:

- Commitment to perform: The actions that the organization must take to establish the process and ensure that it can endure. Commitment to perform typically involves establishing organizational policies and sponsorship.
- Ability to perform: The preconditions that must exist in the project or organization to implement the process competently. Ability to perform typically involves allocating resources, establishing effective organizational structures, and ensuring that personnel have the needed training.
- Activities performed: The roles and procedures necessary to implement the process. Activities performed typically involve establishing plans and procedures, performing the work, tracking it, and taking appropriate management actions.

- Measurement and analysis: The activities performed to measure the process and analyze the measurements. Measurement and analysis typically include defining the measurements to be taken and the analyses to be conducted to determine the status and effectiveness of the activities performed.
- Verifying implementation: The steps to ensure that the activities are performed in compliance with the process that has been established. Verification typically includes reviews by management.

In accordance with SEI's SCE method, for each KPA in level 2 and the one KPA in level 3 (risk management), we evaluated institutional policies and practices and compared project-specific guidance and practices against the five common attributes. This project-specific comparison can result in one of four possible outcomes: (1) project strength—effective implementation of the key practice, (2) project weakness—ineffective implementation of a key practice or failure to implement a key practice, (3) project observation—key practice evaluated but evidence is inconclusive and cannot support characterization as either a strength or a weakness, and (4) not rated—key practice not currently relevant to project, therefore not evaluated.

Customs Lacks the Capability to Develop ACE Software Effectively

In February 1999, we reported that NCAP 0.1 did not fully satisfy any of the KPAs that SEI's SW-CMM requires to be CMM level 2 or repeatable.[2] While NCAP 0.1 exhibited many strengths in three KPA's—requirements management, software project planning, and software project tracking and oversight—it had numerous and significant weaknesses in the remaining two KPA's—software quality assurance and software configuration management. As a result, Customs' ACE software development capability is immature.

In our February 1999 report, we also stated that Customs lacked a software process improvement program. Without one, it is unlikely that Customs can effectively address its software process weaknesses. Accordingly, we recommended that, after ensuring that its mission-critical systems are Year 2000 compliant, but before investing in major software development efforts like ACE, Customs (1) assign responsibility and authority for software process improvement, (2) develop and implement a formal plan for software process improvement that, among other things, was based on our software development process maturity findings, (3) ensure that every new software development effort in Customs adopts

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[2]GAO/AIMD-99-35, February 11, 1999.

processes that satisfy at least SW-CMM level 2 requirements, and (4) ensure that process improvement activities be initiated for all ongoing essential software maintenance projects. Customs agreed with our findings and stated its commitment to software process improvement and maturity, including stating its plans for establishing a software process improvement program and addressing the weaknesses that we identified.

Each of the five SW-CMM KPAs, along with examples of how the ACE software development organization compares to each KPA practices, is summarized below. (See appendix III for more detailed information on the KPAs and our findings.)

Requirements Management

The purpose of requirements management is to establish a common understanding of the requirements between the customer and the software developers. According to the SW-CMM, a repeatable requirements management process, among other things, includes (1) documenting the system requirements allocated to software, (2) providing adequate resources and funding for managing the allocated requirements, (3) training members of the software engineering group to perform their requirements management activities, (4) using the allocated requirements as the basis for software plans, work products, and activities, (5) following a written organizational policy for requirements management, and (6) having a quality assurance group that reviews the activities and work products for managing allocated requirements and reports the results.

The NCAP 0.1 project exhibited strengths in almost all key practices within the requirements management KPA. For example, (1) the system requirements allocated to software were documented, (2) adequate resources and funding were provided for managing the allocated requirements, (3) members of the software engineering group were trained to perform their requirements management activities, and (4) the software developers used the allocated requirements as the basis for software plans, work products, and activities.

Nevertheless, two very important requirements management key practices were not being performed on the NCAP 0.1 project. Specifically, there was no written organizational policy for requirements management and there was no quality assurance group to review the activities. In the absence of these practices, management is missing important means for ensuring that software requirements are managed in a prescribed manner.

Software Project Planning

The purpose of software project planning is to establish reasonable plans for performing software engineering and for managing the software project. According to the SW-CMM, a repeatable software project planning process, among other things, includes (1) documenting the software project plan, and preparing plans for software engineering facilities and support tools, (2) identifying the work products needed to establish and maintain control of the software project, (3) making and using measurements to determine the status of planning activities, (4) following a written organizational policy for planning a software project, (5) training personnel in software project planning and estimating, (6) estimating the software project's efforts, costs, critical computer resources, and schedule according to documented procedures, and (7) having a quality assurance group that reviews the activities and work products for software project planning and reports the results.

The NCAP 0.1 project exhibited strengths in many of the key practices within the software project planning KPA. For example, (1) the software project plan and plans for the software engineering facilities and support tools were documented, (2) software work products that are needed to establish and maintain control of the project were identified in the project plan, and (3) measurements were made and used to determine the status of software planning activities.

However, we also found several significant key practice weaknesses. Specifically, (1) NCAP 0.1 did not follow a written policy for planning a software project, (2) project personnel were not trained in project planning and estimating procedures, (3) estimates for the software project's effort and costs, critical computer resources, and project schedule were not derived according to documented procedures, and (4) there was no software quality assurance group to review or audit the activities and work products for software project planning. Such project planning weaknesses mean that management has no assurance that it will get the consistent, complete, and reliable information about the project's expected costs and schedules needed to make expeditious and informed investment decisions.

Software Project Tracking and Oversight

The purpose of software project tracking and oversight is to provide adequate visibility into the progress of the software development so that management can take effective actions when the software project's performance deviates significantly from the software plans. According to the SW-CMM, effective software project tracking and oversight, among other

things, includes (1) designating a project software manager to be responsible for the project's software activities and results, (2) having a documented software development plan for tracking software activities and communicating status, (3) conducting periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan, (4) periodically reviewing the activities for software project tracking and oversight with senior management, (5) following a written organizational policy for managing the project, (6) training software project managers in the technical and personnel aspects of the software project, (7) reviewing software project commitments and changes to commitments with senior management, and (8) independently reviewing or auditing the activities and work products for software project tracking and oversight.

NCAP 0.1 exhibited strengths in most of the key practices within the software project tracking and oversight KPA. For example, (1) a project manager had been designated to be responsible for the project's software activities and results, (2) the project had a documented software development plan, (3) the software engineering group conducted periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan (e.g., the sizes of software work products and the risks associated with software costs, resources, and schedule), and (4) software project tracking and oversight activities were reviewed with senior management on a weekly basis.

However, significant weaknesses also existed. For example, (1) there was no written organizational policy for managing the software project, (2) the software managers were not trained in managing the technical and personnel aspects of the software project, (3) software project commitments and changes to commitments were not reviewed with senior management, and (4) because no software quality assurance group exists, there were no independent reviews or audits of the activities and work products for software project tracking and oversight.

Software Quality Assurance

The purpose of software quality assurance is to independently review and audit software products and activities to verify that they comply with applicable procedures and standards and to provide the software project and higher level managers with the results of these independent reviews and audits. According to the SW-CMM, a repeatable software quality assurance process, among other things, includes (1) preparing a software quality assurance plan according to a documented procedure, (2) having a

written organizational policy for implementing software quality assurance, (3) conducting audits of designated work processes and products to verify compliance, (4) documenting deviations identified in the software activities and software work products and handling them according to a documented procedure, and (5) having experts independent of the software quality assurance group periodically review the activities and work products of the project's software quality assurance group.

NCAP 0.1 did not satisfy any of the key practices within the software quality assurance KPA. Because its software quality assurance is ineffective, ACE is at risk that (1) process and product standards will not be met and (2) software will not perform as intended, and will cost more and take longer to develop than expected.

Software Configuration Management

The purpose of software configuration management is to establish and maintain the integrity of the products of the software project throughout the project's software life-cycle. According to the SW-CMM, a repeatable software configuration management process, among other things, includes (1) preparing a software configuration management plan according to a documented procedure, (2) establishing a configuration management library system as a repository for the software baselines, (3) identifying software work products to be placed under configuration management, (4) controlling the release of products from the software baseline library according to a documented procedure, (5) following a written organizational policy for implementing software configuration management, (6) recording the status of configuration items/units according to a documented procedure, (7) making and using measurements to determine the status of software configuration management activities, and (8) periodically reviewing software configuration management activities with senior management.

NCAP 0.1 had strengths in several of the key practices within the software configuration management KPA. For example, (1) a software configuration management plan was developed according to a documented procedure, (2) a configuration management library system was established as a repository for the software baselines, (3) software work products to be placed under configuration management were identified, and (4) the release of products from the software baseline library was controlled according to a documented procedure.

However, NCAP 0.1 exhibited weaknesses in most of the software configuration management key practices, which collectively jeopardize Customs' ability to maintain the integrity of the project's software products. Specifically, (1) there was no organizational policy for implementing software configuration management, (2) the status of configuration management items was not recorded according to a documented procedure, (3) no measurements were taken to determine the status of software configuration management activities, and (4) software configuration management activities were not periodically reviewed with senior management.

Customs Lacks the Capability to Acquire ACE Software Effectively

NCAP 0.2 did not fully satisfy any of the KPA's that SEI's SA-CMM requires to be a CMM level 2 or repeatable. We found extensive weaknesses in all KPA's except one—requirements development and management. Each of the eight KPA's, along with examples of how Customs' software acquisition processes compare to the KPA goals, is summarized below. (See appendix IV for more detailed information on KPAs and our findings.)

Software Acquisition Planning

The purpose of software acquisition planning is to ensure that reasonable planning for the software acquisition is conducted and that all aspects of the total software acquisition effort are included in these plans. According to the SA-CMM, a repeatable software acquisition planning process, among other things, includes (1) having a written software acquisition policy, (2) developing and documenting the software acquisition strategy and plan, (3) having management review software acquisition planning activities, and (4) making and using measurements to determine the status of software acquisition planning activities.

NCAP 0.2 had no strengths in this KPA. For example, (1) the project followed no written policy for planning the software acquisition, (2) there was no documented software acquisition strategy or plan, (3) software acquisition planning activities were not being reviewed by management, and (4) software acquisition planning activities were not being measured. As a result, management lacks an effective means to identify problems in project performance and take corrective action expeditiously.

Solicitation

The purpose of solicitation is to prepare a request for proposal that delineates a project's software-related requirements, and, consistent with relevant solicitation laws and regulations, select a contractor that can

most cost-effectively satisfy these requirements. According to the SA-CMM, specific requirements for a repeatable solicitation process include, among other things, (1) designating responsibility for the software portion of the solicitation, (2) designating a selection official to be responsible for the selection process and decision, (3) preparing cost and schedule estimates for the software products and services being acquired, (4) having a written policy for the conduct of the software portion of the solicitation, (5) having and following a solicitation plan, (6) independently reviewing cost and schedule estimates for the software products and services being acquired, and (7) making and using measurements to determine the status of the solicitation activities and resultant products.

NCAP 0.2 had some strengths in this area, including (1) designating responsibility for the software solicitation, (2) designating a selection official for the selection process and decision, and (3) preparing cost and schedule estimates for the software products and services being acquired.

However, we found many weaknesses, including (1) no written policy for the conduct of the software solicitation and (2) no solicitation plans to guide the performance of solicitation activities. These weaknesses increase the risk of Customs not adequately or uniformly evaluating the offerors' proposals, and making a suboptimal selection. Other weaknesses included (1) no independent review of software cost and schedule estimates and (2) no measurements to determine the status of solicitation activities and resultant products. As a result, management cannot identify solicitation problems early and resolve them expeditiously.

Requirements Development and Management

The purpose of requirements development and management is to establish and maintain a common and unambiguous definition of software requirements among the acquisition team, the system users, and the software development contractor. This KPA involves two subprocesses: (1) developing a baseline set of software-related contractual requirements and (2) managing these requirements and changes to these requirements for the duration of the acquisition.

SA-CMM requirements development and management practices necessary to achieve a repeatable maturity include (1) having a group that is responsible for performing requirements development and management activities, (2) ensuring that individuals performing requirements development and management activities have experience or receive training, (3) measuring and reporting on the status of requirements

development and management activities and resultant products to management, (4) periodically reviewing requirements development and management activities by acquisition organization management, (5) having a written organizational policy for establishing and managing the software-related contractual requirements, (6) performing requirements development and management activities in accordance with documented plans, (7) appraising the impact of system requirements change requests on the software being acquired, and (8) maintaining traceability between the software-related contractual requirements and the contractor's software work products.

NCAP 0.2 had many strengths in requirements development and management. For example, (1) there was a group that is responsible for performing requirements development and management, (2) group members had experience or have received training in the activities, (3) measurements of requirements development and management activities were made, and (4) management reviewed the activities periodically.

However, we found weaknesses in important key practices that jeopardize effective control of the requirements baseline and can result in software products that do not meet cost, schedule, or performance objectives. Specifically, (1) there was no written policy for establishing and managing the software-related contractual requirements, (2) there was no documented requirements development and management plan, (3) system requirements change requests were not appraised for their impact on the software being acquired, and (4) traceability between the software-related contractual requirements and the contractor's software work products was not maintained.

Project Office Management

The purpose of project office management is to manage the activities of the project office and supporting contractors to ensure a timely, efficient, and effective software acquisition. According to the SA-CMM, effective project office management requires, among other things, (1) designating responsibility for project management, (2) providing project teams with authority to alter either the project's performance, cost, or schedule baseline, (3) having a written policy for the management of the software project, (4) using a software acquisition management plan, and (5) using a corrective action system for identifying, recording, tracking, and correcting problems.

NCAP 0.2 had several practice strengths in the KPA including (1) designating a project manager as responsible for the project and (2) providing project teams with authority to change either the performance, cost, or schedule software acquisition baseline when necessary. However, we found numerous weaknesses, including (1) no written policy for management of the software project, (2) no software acquisition management plan, and (3) no corrective action system. These weaknesses jeopardize the project's ability to ensure that important project office and contractor activities are defined, understood, and completed.

Contract Tracking and Oversight

The purpose of contract tracking and oversight is to ensure that the software development contractor performs according to the terms of the contract; needed contract changes are identified, negotiated, and incorporated into the contract; and contractor performance issues are identified early, when they are easier to address. According to the SA-CMM, a repeatable contract tracking and oversight process, among other things, includes (1) designating responsibility for contract tracking and oversight, (2) providing support for the project team by contracting specialists, (3) ensuring that individuals performing contract tracking and oversight are suitably experienced or trained, (4) having a written organizational policy for contract tracking and oversight, (5) having a documented plan for contract tracking and oversight, (6) reviewing required contractor software planning documents to oversee the contractor's software engineering effort, and (7) tracking problems or issues found by the project team during contract tracking and oversight in a corrective action system.

NCAP 0.2 had several strengths in this KPA, including (1) designating responsibility for contract tracking and oversight activities, (2) providing contracting specialist support to the project team, and (3) ensuring that personnel responsible for contract tracking and oversight are suitably experienced or trained. However, we found significant weaknesses, including (1) no written organizational policy for contract tracking and oversight, (2) no documented contract tracking and oversight plan, (3) no required contractor software planning documents that could be used to oversee the contractor's software engineering effort, and (4) no corrective action tracking system for recording problems or issues found by the project team. Because of these weaknesses, Customs' contractor tracking and oversight activities are undisciplined and unstructured, thereby increasing the chances of its software acquisitions being late, costing more than expected, and not performing as intended.

Evaluation

The purpose of evaluation is to determine that the acquired software products and services satisfy contract requirements prior to acceptance. According to the SA-CMM, a repeatable evaluation process includes (1) designating responsibility for planning, managing, and performing evaluation activities, (2) ensuring that individuals performing evaluation activities have experience or receive training, (3) managing the evaluation of the acquired software according to a written policy, (4) documenting evaluation plans and conducting evaluation activities in accordance with the plan, (5) developing and managing evaluation requirements in conjunction with developing software technical requirements, (6) tracking contractor performance of evaluation activities for compliance with the contract, and (7) measuring and reporting on the status of evaluation activities to management.

NCAP 0.2 had some evaluation strengths, including (1) designating responsibility for planning, managing, and performing evaluation activities and (2) ensuring that individuals performing evaluation activities have experience or receive training. However, we found many significant weaknesses, including, (1) there was no written policy for managing the evaluation of the acquired software, (2) there was no documented evaluation plan to use as the basis for conducting evaluation activities, (3) evaluation requirements were not developed in conjunction with development of the system or software technical requirements, (4) contractor evaluation activity performance was not tracked for compliance with the contract, and (5) no measurements were made to determine the status of evaluation activities. Because of these pervasive evaluation weaknesses, Customs has no assurance that contractor-developed ACE software will satisfy defined requirements.

Transition and Support

The purpose of transition and support is to provide for the effective and efficient "hand-off" of the acquired software products to the support organization responsible for software maintenance. According to the SA-CMM, repeatable transition and support processes, among other things, include (1) having a written policy for transitioning software products to the support organization, (2) designating a group that is responsible for coordinating transition and support activities, (3) performing project activities in accordance with a documented transition and support plan, and (4) measuring the status of the transition and support activities.

NCAP 0.2 had no practice strengths in the transition and support KPA. In particular, (1) there was no written policy for the transitioning of software

products to the software support organization, (2) there was no designated group responsible for coordinating transition and support activities, (3) there was no transition and support plan, and (4) the status of transition and support activities were not measured. As a result, Customs is not effectively positioned to assume support responsibility for the ACE software that it acquires.

Acquisition Risk Management

The purpose of acquisition risk management is to formally identify risks as early as possible and adjust the acquisition to mitigate those risks. According to the SA-CMM, an effective risk management process, among other things, includes (1) having a written policy on acquisition risk management, (2) developing a software acquisition risk management plan, (3) conducting software risk management activities in accordance with the plan (e.g., identifying risks, taking mitigation actions, and tracking risk mitigation actions to completion), and (4) measuring and reporting on the status of acquisition risk management activities to management.

NCAP 0.2 was weak in all key practices of acquisition risk management. In particular, (1) there was no written policy on acquisition risk management, (2) there was no software acquisition risk management plan, (3) no risk management activities were being performed, and (4) no measurements were taken to determine the status of risk management activities. Because of these weaknesses, Customs has no assurance that it will identify risks early and effectively mitigate them.

Conclusions

Customs' software acquisition and development processes are insufficiently mature to support the effective development or acquisition of ACE. Until these processes are strengthened, there is no basis for confidence that ACE will be delivered on time, within budget, or perform as specified.

Overall Conclusions, Recommendations, and Agency Comments

Successful systems modernization is critical to Customs' ability to implement the provisions of its legislative mandates and to achieve its goals of increased compliance with trade laws and speedier processing of imports. However, Customs currently lacks the full management and technical capability needed to successfully modernize its systems. As a result, satisfaction of its legislative mandate and realization of the attendant benefits by both Customs and the trade community are in jeopardy.

With ACE, Customs has not adequately demonstrated that it is "doing the right thing," i.e., that the system that it is building is the most cost effective system for meeting the needs of Customs and the trade community. Specifically, by not having a complete information systems architecture to guide the development and evolution of its systems, including ACE, Customs runs the risk that its efforts will not provide optimum performance and will be incompatible and expensive to maintain. Also, by using unreliable and incomplete ACE cost and benefit data, Customs does not know if ACE is a cost effective system solution to its needs, or if its investments in ACE are wise.

Customs also has not clearly demonstrated that it is developing ACE "the right way." In particular, without incrementally managing such a mammoth system as ACE, Customs will not know whether its cost and benefit expectations are being met until it has already spent hundreds of millions of dollars. Such a "grand design" approach has proven repeatedly to be ineffective and has been abandoned by successful IT organizations. Additionally, because its ability to develop or acquire software is immature, Customs can do neither effectively. Therefore, its software acquisition and development processes must be strengthened before it can hope to acquire or develop ACE software on time and within budget, as well as to achieve expected benefits.

Recommendations

In addition to previous recommendations to improve Customs' management of information technology,[1] we recommend that Customs correct the management and technical weaknesses discussed in this report before building ACE. To accomplish this, GAO recommends that the Commissioner of Customs, with the support of Customs' CIO, ensure that Customs

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[1]GAO/AIMD-99-35, February 11, 1999 and GAO/AIMD-98-70, May 5, 1998.

(1) rigorously analyze alternative approaches to building ACE, including ITDS as an alternative to developing ACE entirely within Customs and;

(2) make investment decisions incrementally, i.e., for each increment:

- use disciplined processes to prepare a rigorous life-cycle cost estimate, including an explicit discussion of its inherent uncertainty;
- prepare realistic and supportable benefit expectations;
- require a favorable return-on-investment and compliance with Customs' architecture before making any investment; and
- validate actual costs and benefits once an increment is piloted, compare these with estimates, use the results in making further decisions on subsequent increments, and report the results to Customs' House and Senate appropriations and authorizing committees; and

(3) strengthen ACE software acquisition management by:

- establishing an effective process improvement program and correcting the weaknesses in ACE software acquisition processes identified in this report, thereby bringing ACE processes to at least SEI level 2 and
- requiring at least SEI level 2 processes of all ACE software contractors.

Agency Comments

In its written comments on a draft of this report, Customs agreed with our conclusions and recommendations and stated that it is committed to addressing the problems discussed in the report. To this end, Customs cited a number of actions that it has underway and planned to improve management of information technology in general, and ACE specifically. For example, Customs stated that it has recruited a CIO with extensive experience in enterprise architecture and major systems acquisition, reorganized its Office of Information and Technology, and revised its System Development Life Cycle process. Also, Customs stated that it has engaged a contractor to update and improve the ACE cost-benefit analysis and plans for another contractor to independently review the new ACE cost-benefit analysis. Additionally, Customs reported that it revised its investment management procedures to provide for effective systems architecture enforcement, as we recommended in our May 1998 report.[2] The report has been modified to reflect this information. To fully correct the management and technical weaknesses discussed in this report, Customs must follow through and effectively implement its plans to

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[2]GAO/AIMD-98-70, May 5, 1998.

address all of our recommendations. Appendix I provides the full text of
Customs' comments.

Comments From the U.S. Customs Service

THE COMMISSIONER OF CUSTOMS

February 16, 1999   WASHINGTON, D.C.

Mr. Gene L. Dodaro
Assistant Comptroller General
General Accounting Office
Washington, D.C. 20548

Dear Mr. Dodaro:

Thank you for the opportunity to review your draft report entitled, "Customs Service Modernization: Serious Management and Technical Weaknesses Must Be Corrected."

Customs concurs with GAO's findings and recommendations. We recognize the importance of this review and have already taken corrective actions to address your findings. In addition other actions are planned.

We agree with GAO on the importance of an enterprise architecture to make sound systems investment decisions, to develop well-justified cost benefit analyses, and to improve the software development and acquisition processes. We believe you will find that Customs is firmly committed to successfully responding to these issues.

This commitment will likely span several years and require a substantial amount of resources. Given the static level of Customs Information Technology budget for the past 6 years, it will be difficult to implement the GAO recommendations while maintaining a viable automated commercial system. Assistance like that provided for the Y2K effort from Treasury, OMB, and Congress will be crucial to our success. We hope you will take the resource considerations, time factors and need to maintain the current ACS system into consideration when you finalize your report.

We at Customs want to thank you and your staff for the assistance provided in this review.

Sincerely,

Raymond W. Kelly
Commissioner

Enclosure

REPORT DRUG SMUGGLING TO UNITED STATES CUSTOMS SERVICE 1–800–BE–ALERT

ENCLOSURE

Customs is committed to addressing the problems cited in GAO's draft report as demonstrated by the actions listed below which have been taken or are in progress.

- The Deputy Commissioner, chair of Customs Investment Review Board, mandated on January 21, 1999, that all proposed information technology (IT) investments conform with the enterprise architecture, or provide detailed justification why they should be excepted. This responds to GAO's recommendation that we make explicit what has been our practice.

- On October 23, 1998, the Chief Information Officer (CIO) directed the use of a revised Systems Development Life Cycle (SDLC) process to provide a standards-based approach for systems development. On December 1, 1998, the CIO reiterated the mandate for training in and compliance with the SDLC.

- The investment management process has been amended to provide for reviews for adherence to SDLC requirements prior to allowing applications development projects to proceed. Procedures are being developed now and will be implemented no later than April 1999.

- Recognizing the need to improve the organizational capability to document comprehensive justification for proposed IT investments, cost/benefit training in a standardized methodology and an automated tool has been provided to more than 75 employees responsible for IT investments.

- Recognizing the need to improve Customs IT management, a CIO with extensive experience in enterprise architecture and major systems acquisition was recruited to provide effective leadership to managing information resources.

- Effective January 17, the Office of Information Technology (OIT) was reorganized to provide for improved accountability. An important element of the reorganization was the establishment of staff offices for Technology and Architecture, Strategic Planning, Program Monitoring, and Resource Management that are responsible to the CIO for: improved investment management; further progress on the enterprise architecture; enhanced controls over software development; and, the development and implementation of software process improvement plans to achieve Capability Maturity Model (CMM) levels 2 and 3 for software development and acquisition over the next 2-5 years.

- Recognizing the need to improve Customs performance against the CMM, the CIO has been meeting with both government and private sector organizations that have achieved CMM levels 2 and above to ascertain lessons learned to incorporate into Customs plan for achieving CMM levels 2 and 3.

- Engaged a contractor to update and improve the Automated Commercial Environment (ACE) costs-benefit analysis (CBA). The analysis is incorporating direction previously provided by GAO staff in their close-out conference on the August 1997 CBA. This analysis reflects use of the International Trade Data System (ITDS) as the trade interface for ACE. This analysis will be available for external review in April.

- Engaged Klynveld Peat Marwick Goerdelev (KPMG) to provide an independent review of Customs methodology and assumptions for software development and infrastructure costs. KPMG's preliminary review found our approaches for cost estimation to be sound and appropriate. KPMG will also perform an independent review of the completed CBA.

- A directive is being developed that will require that all software contractors that do business with Customs be certified at least at CMM level 2.

Beyond these steps that have already been taken, Customs commits to the actions listed below.

- Have a plan in place in April 1999 for achieving CMM level 2 by December 2000. This will provide for improved software development and acquisition controls prior to any further substantial investment in ACE.

- Have the revised ACE CBA available for external review in April 1999.

- After holding clarifying meetings with GAO and other interested parties, commit to a milestone for refining the upcoming CBA to compare the ACE scenario to alternatives and to provide justification for ACE increments.

- Contract with a firm or firms with demonstrated capabilities for project management support and adherence to CMM level 3 to guide enterprise improvement in software development and acquisition and in serving as a resource for ACE project management support.

- Contract out the design and development of future ACE functionality. The CIO is meeting with the Internal Revenue Service and its prime contractor to evaluate the applicability of their arrangement for Customs.

The actions listed above that have been taken, are in progress, or which are planned demonstrate Customs commitment to improve its management of IT. The actions already taken indicate that Customs has recognized many of these problems and has been working vigorously to correct them. While we commit to addressing remaining GAO concerns, we have made progress in addressing important IT challenges.

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- Customs enterprise architecture efforts have been closely reviewed and endorsed by the Treasury Investment Review Board. Further, on December 10, 1998, the CIO Council's Federal Architecture Working Group cited Customs as a leading edge agency in developing an enterprise architecture.

- Recognizing the seriousness of the Year 2000 systems and infrastructure renovation problem, we implemented a structured, disciplined approach that has met all Treasury time frames for mission critical systems renovation and testing and has received positive recognition by GAO, Treasury and others.

- While we agree to improve the management and justification of the ACE effort, we have followed accepted business process reengineering procedures by working with the trade to define what the future trade compliance process should be; received endorsements by external groups such as the Gartner Group and Private Sector Council as to the need for and basic soundness of the ACE concept; and implemented two highly successful prototype releases that have demonstrated the value of the reengineered business process.

While Customs commits to strengthening IT management, all parties need to recognize that this will take time and resources. Progress in achieving higher levels of performance against CMM standards has taken organizations 2-5 years and required substantial resource commitments. Given the static level of Customs IT budget over the past six years, it will be difficult to deliver on the GAO recommendations while also maintaining a viable automated commercial system unless we receive assistance such as was provided for the Y2K effort by Treasury, OMB, and the Congress.

Detailed Comparison of SEI's Checklist for Reliable Cost Estimates and Customs' Practices for Estimating ACE Costs

The following seven tables rate Customs' practices for estimating life-cycle costs of $1.05 billion against SEI's criteria for reliable cost estimating. A strength indicates that Customs satisfied the SEI criterion; a weakness indicates that it did not. Where evidence was inconclusive and did not clearly support a determination of either strength or weakness, a rating of "observation" was given.

Table II.1: Are the Objectives of the Estimate Clear and Correct?

SEI checklist item	Finding	Rating
The objectives of the estimate are stated in writing.	The objectives of the estimates are stated in writing.	Strength
The life-cycle to which the estimate applies is clearly defined.	The 10-year life-cycle is clearly defined for the ACE cost estimate, and consists of 6 years of development and deployment and 4 years of operations and maintenance.	Strength
The tasks and activities included in (and excluded from) the estimate are clearly identified.	The tasks and activities that Customs included in (and excluded from) the estimate are clearly identified.	Strength
The tasks and activities included in the estimate are consistent with the objectives of the estimate.	The tasks and activities included in the estimate are consistent with the stated objectives of the estimate.	Strength

Table II.2: Has the Task Been Appropriately Sized?

SEI checklist item	Finding	Rating
A structured process has been used to estimate and describe the size of the software project.	A structured process has not been used to estimate and describe the size of the entire software project. Customs followed a structured process for estimating the size of NCAP 0.1, the first ACE software release; however, the methodology used to estimate the size of NCAP 0.2 and all subsequent ACE software releases was not structured and lacked critical elements, such as defined functional requirements for NCAP 0.2 and all subsequent releases.	Weakness
A structured process has been used to estimate and describe the extent of software reuse.	A structured process has not been used to estimate and describe the extent of software reuse. According to Customs officials, software reuse was discussed during an ACE planning conference; however, the results were not documented.	Weakness
The processes for estimating size and reuse are documented.	The processes for estimating size and reuse are not documented. The documentation available on the estimate, including the ACE/NCAP workload estimate spreadsheets, does not document the size and reuse estimating processes followed by Customs.	Weakness
The descriptions of size and reuse identify what is included in (and excluded from) the size and reuse measures used.	The description of size identifies what is included in the size measures used (e.g., screens, business objects, and operations); however, no description of reuse measures exists.	Weakness
The measures of reuse distinguish between code that will be modified and code that will be integrated as is into the system.	The measures of reuse are not documented; however, the ACE workload estimate spreadsheets do include an estimate of existing code that will be modified for use in subsequent NCAP software releases.	Observation
The definitions, measures, and rules used to describe size and reuse are consistent with the requirements (and calibrations) of the models used to estimate cost.	Customs did not use a model to estimate the cost of ACE. Furthermore, the reuse definitions, measures, and rules are not documented.	Weakness
The size estimate was checked by relating it to measured sizes of other software products or components.	The size estimate for the entire ACE project was not checked by relating it to measured sizes of other software products or components. Customs did not have a comparable internal software product to benchmark against at the time of the estimate. According to Customs officials, the NCAP 0.1 size estimate was compared (via informal and undocumented telephone inquiries) to similar products and components previously developed outside of Customs. The size estimate for NCAP 0.2 and subsequent releases was based upon the NCAP 0.1 size estimate.	Weakness
The size estimating process was checked by testing its predictive capabilities against measured sizes of completed products.	The size estimating process was not checked by testing its predictive capabilities against measured sizes of completed projects.	Weakness

Table II.3: Is the Estimated Cost Consistent With Demonstrated Accomplishments on Other Projects?

SEI checklist item	Finding	Rating
The organization has a structured process for relating estimates to actual costs of completed work —the process is documented —the process was followed.	Customs does not have a structured, documented process for relating estimates to actual costs of completed work.	Weakness
The cost models that were used have been calibrated to relevant historical data. (Models of some sort are needed to provide consistent rules for extrapolating from previous experience.)	Customs did not use a cost model and did not have any relevant historical data to calibrate.	Weakness
The cost models quantify demonstrated organizational performance in ways that normalize for differences among software products and projects. (So that a simple, unnormalized, lines-of-code per staff-month extrapolation is NOT the basis for the estimate.)	Customs did not use a cost model. Further, Customs changed its software development approach from an in-house development (NCAP 0.1) to an acquisition (NCAP 0.2). Nonetheless, Customs used the NCAP 0.1 estimate as the basis for extrapolating the estimate for the remaining ACE releases without normalizing the NCAP 0.1 data to account for the differences in the approaches.	Weakness
The consistency achieved when fitting the cost models to historical data has been measured and reported.	Customs did not use a cost model. At the time that the ACE cost estimate was developed, Customs had no historical data with which to evaluate consistency. Cost data are currently being collected, but the collected data has not been used to measure and report the consistency achieved when using the cost models.	Weakness
The values used for cost models' parameters appear valid when compared to values that fit the models well to past projects.	Customs did not use a cost model; therefore, comparison of cost models' parameter values to those used on past projects was not done.	Weakness
The calibration of cost models was done with the same versions of the models that were used to prepare the estimate.	Customs did not use cost models; therefore, calibration was not done.	Weakness
The methods used to account for reuse recognize that reuse is not free. (The estimate accounts for activities such as interface design, modification, integration, testing, and documentation that are associated with effective reuse.)	The methods used to account for reuse recognize that reuse is not free. The Customs estimating spreadsheets account for activities associated with NCAP software reuse, such as modification of existing code, integration, and testing.	Strength
Extrapolations from past projects account for differences in application technology. (For example, data from projects that implemented traditional mainframe applications require adjustments if used as a basis for estimating client-server implementation. Some cost models provide capabilities for this, others do not.)	Extrapolations from NCAP 0.1 to NCAP 0.2 and subsequent releases did not account for differences in application technology (e.g., the change in architecture from the legacy mainframe system to a combined mainframe and Internet-based client-server system).	Weakness
Extrapolations from past projects account for observed, long-term trends in software technology improvement. (Although some cost models attempt this internally, the best methods are usually based on extrapolating measured trends in calibrated organizational performance.)	Extrapolations from NCAP 0.1 to NCAP 0.2 and subsequent releases did not account for differences in tools, languages, and personnel due to the change in architecture from the legacy mainframe system written in COBOL and C_{++} to a combined mainframe and Internet-based system written in C_{++} and Java.	Weakness

(continued)

SEI checklist item	Finding	Rating
Extrapolations from past projects account for the effects of introducing new software technology or processes. (Introducing a new technology or process can initially reduce an organization's productivity.)	Extrapolations from NCAP 0.1 to NCAP 0.2 and subsequent releases did not account for the change in process from an in-house software development project (NCAP 0.1) to a software acquisition (NCAP 0.2).	Weakness
Work-flow schematics have been used to evaluate how this project is similar to (and how it differs from) projects used to characterize the organization's past performance.	Work-flow schematics have not been used to evaluate how this project is similar to (and how it differs from) projects used to characterize the organization's past performance.	Weakness

Table II.4: Have the Factors That Affect the Estimate Been Identified and Explained?

SEI checklist item	Finding	Rating
A written summary of parameter values and their rationales accompanies the estimate.	A written summary of the parameters affecting the cost estimate exists; however, a written summary of the values used and their rationales does not exist.	Weakness
Assumptions have been identified and explained.	The assumptions have been identified and explained.	Strength
A structured process such as a template or format has been used to ensure that key factors have not been overlooked.	Customs has used spreadsheets designed specifically for the ACE NCAP project in an effort to ensure that key factors have not been overlooked.	Strength
Uncertainties in parameter values have been identified and quantified.	No uncertainties in parameter values were identified or quantified.	Weakness
A risk analysis has been performed, and risks that affect cost have been identified and documented. (Elements addressed include issues such as probability of occurrence, effects on parameter values, cost impacts, schedule impacts, and interactions with other organizations.)	A risk analysis has been performed, and risks that affect cost have been identified and documented (e.g., lack of requirement definition for later releases, technical complications, stability of development and configuration management environments and process).	Strength

Table II.5: Have Steps Been Taken to Ensure the Integrity of the Estimating Process?

SEI checklist item	Finding	Rating
Management reviewed and agreed to the values for all descriptive parameters before costs were estimated.	According to Customs project officials, management reviewed and agreed to the values for all descriptive parameters before costs were estimated; however, management approval has not been documented.	Observation
Adjustments to parameter values to meet a desired cost or schedule have been documented.	Not applicable. According to Customs project officials, no adjustments to parameter values to meet a desired cost or schedule were made.	N/A
If a dictated schedule has been imposed, the estimate is accompanied by an estimate of (1) the normal schedule and (2) the additional expenditures required to meet the dictated schedule.	Not applicable. According to Customs project officials, no dictated schedule has been imposed.	N/A
Adjustments to parameter values to meet a desired cost or schedule are accompanied by management action that makes the values realistic.	Not applicable. No adjustments to parameter values were made, and thus no accompanying management action occurred.	N/A
More than one cost model or estimating approach has been used, and the differences in results have been analyzed and explained.	Two estimating approaches (spreadsheets) were used for NCAP, and the resulting differences in the estimates (within 15 percent) have been analyzed and explained.	Strength
People from related but different projects or disciplines were involved in preparing the estimate.	People from the requirements, design, systems engineering, integration, testing, and project management teams were involved in preparing the estimate.	Strength
At least one member of the estimating team is an experienced estimator, trained in the cost models that were used.	Two members of the estimating team have practical experience, but none have been trained in cost estimating and cost models.	Observation
Estimators independent of the performing organization concur with the reasonableness of the parameter values and estimating methodology.	According to Customs project officials, estimators independent of the performing organization concurred with the reasonableness of the parameter values and estimating methodology, but their analysis is not documented.	Observation
The groups that will be doing the work accept the estimate as an achievable target.	Customs (NCAP 0.1 developer) and the contractor (NCAP 0.2 developer) accepted the estimates as achievable targets.	Strength
Memorandums of agreement have been completed and signed with the other organizations whose contributions affect cost.	No memorandums of agreement have been completed and signed with the requirements, design, systems engineering, integration, testing, project management team, and other organizations whose contributions affect cost.	Weakness

Table II.6: Is the Organization's Historical Evidence Capable of Supporting a Reliable Estimate?

SEI checklist item	Finding	Rating
The estimating organization has a method for organizing and retaining information on completed projects (a historical database).	Customs did not have a method for organizing and retaining information on completed projects (a historical database) at the time that this estimate was developed. (Note: Customs has since developed a historical database which contains planned versus actual results for schedule, effort, and cost and plans to use this in future estimates.)	Weakness
The database contains a useful set of completed projects.	Customs did not have a historical database at the time this estimate was developed. (Note: The database developed later contains NCAP 0.1 and 0.2 data only. No data from other completed projects is included.)	Weakness
Elements included in (and excluded from) the effort, cost, schedule, size, and reuse measures in the database are clearly identified. (See, for example, the SEI checklists for defining effort, schedule, and size measures.)	Customs did not have a historical database at the time this estimate was developed. Elements included in the effort, cost, and schedule measures in the database Customs has since developed are clearly identified. However, size and reuse measures are not identified in the database.	Weakness
Schedule milestones (start and finish dates) are described in terms of criteria for initiation or completion, so that work accomplished between milestones is clearly bounded.	The schedule milestones (start and finish dates) are accompanied by task and subtask descriptions.	Strength
Records for completed projects indicate whether or not unpaid overtime was used.	Not applicable. According to Customs project officials, unpaid overtime was insignificant and did not warrant recording for NCAP 0.1.	N/A
Unpaid overtime, if used, has been quantified, so that recorded data provide a valid basis for estimating future effort.	Not applicable. According to Customs project officials, unpaid overtime was insignificant and did not warrant recording for NCAP 0.1.	N/A
Cost models that were used for estimating have been used also to provide consistent frameworks for recording historical data. (This helps ensure that comparable terms and parameters are used across all projects, and that recorded data are suitable for use in the estimating models.)	Customs did not use any cost models for estimating. The spreadsheets that were used for cost and workload estimating do not provide a consistent framework for recording historical data for NCAP releases 0.1 and 0.2.	Weakness
The data in the historical database have been examined to identify inconsistencies and anomalies have been corrected or explained. (This is best done with the same cost models used for estimating.)	At the time of the estimate, there was no historical database. (Note: The data in the historical database prepared later have not yet been examined to identify inconsistencies.)	Weakness
The organization has a structured process for capturing effort and cost data from ongoing projects.	Customs has a structured process for capturing effort and cost data from the ACE project on a weekly basis.	Strength
The producing organization holds postmortems at the completion of its projects to (1) ensure that recorded data are valid, and (2) ensure that events that affected costs get recorded and described while they are still fresh in people's minds.	According to project officials, Customs plans to hold postmortems at the completion of each ACE/NCAP software release. NCAP 0.1 was completed but a postmortem has not yet been performed. No documentation exists which describes the postmortem process or structure.	Weakness

(continued)

SEI checklist item	Finding	Rating
Information on completed projects includes —the life-cycle model used, together with the portion covered by the recorded cost and schedule; —actual (measured) size, cost, and schedule; —the actual staffing profile; —an estimate at completion, together with the values for cost model parameters that map the estimate to the actual cost and schedule; —a work breakdown structure or alternative description of the tasks included in the recorded cost; —a work-flow schematic that illustrates the software process used; —nonlabor costs; —management costs; —a summary or list of significant deliverables (software and documentation) produced by the project; and —a summary of any unusual issues that affected cost.	According to Customs project officials, all this information has not yet been collected, but they plan to do so.	Weakness
Evolution in the organization's work-flow schematics shows steady improvement in the understanding and measurement of its software processes.	Customs' historical database on completed software projects represents an effort to understand and measure its software processes. Customs currently has no other ongoing software process improvement efforts.	Weakness

Table II.7: Has the Situation Remained Unchanged Since the Estimate Was Prepared?

SEI checklist item	Finding	Rating
The estimate has not been invalidated by recent events, changing requirements, or management action (or inaction).	The estimate has been invalidated by the following recent actions and events: (1) The approved fiscal year 1999 ACE appropriated funding totals $6 million, which is significantly less than the $75.1 million fiscal year 1999 funding requirement stated in the ACE cost estimate; (2) NCAP 0.1 was developed in-house and the cost estimate for subsequent releases was based on the assumption that they would be developed in-house as well. Customs has since decided to acquire NCAP 0.2 and perhaps subsequent releases from a contractor; and (3) NCAP 0.2 and subsequent releases will utilize a combined mainframe and internet-based client-server architecture instead of the NCAP 0.1 mainframe architecture upon which the estimate was based.	Weakness
The estimate is being used as the basis for assigning resources, deploying schedules, and making commitments.	The estimate is not being used as the basis for assigning resources, deploying schedules, and making commitments. Instead, Customs is using a revised estimate that reflects actual fiscal year 1998 and 1999 ACE appropriated funding, which is significantly less than the funding requirements identified in the ACE cost estimate for fiscal years 1998 and 1999.	Weakness
The estimate is the current baseline for project tracking and oversight.	The estimate is not the current baseline for project tracking and oversight. Instead, Customs is using a revised estimate that reflects actual fiscal year 1998 and 1999 ACE appropriated funding, which is significantly less than the funding requirements identified in the ACE cost estimate for fiscal years 1998 and 1999. Customs is currently tracking actual project costs against these appropriated funds.	Weakness

Results of Software Development Capability Maturity Model (SW-CMM) Evaluation for NCAP 0.1

Table III.1: Key Process Area: Requirements Management

	Key practice	Finding	Rating
Commitment 1	The project follows a written organizational policy for managing the system requirements allocated to software.	There is no written organizational policy for managing the system requirements allocated to software.	Weakness
Ability 1	For each project, responsibility is established for analyzing the system requirements and allocating them to hardware, software, and other system components.	The Process Analysis and Requirements Team is responsible for analyzing system requirements and allocating them to hardware, software, and other system components.	Strength
Ability 2	The allocated requirements are documented.	Allocated requirements are documented.	Strength
Ability 3	Adequate resources and funding are provided for managing the allocated requirements.	Adequate resources and funding are provided for managing the allocated requirements.	Strength
Ability 4	Members of the software engineering group and other software-related groups are trained to perform their requirements management activities.	Members of the software engineering group and other software-related groups are trained to perform their requirements management activities.	Strength
Activity 1	The software engineering group reviews the allocated requirements before they are incorporated into the software project.	The software engineering group reviews the allocated requirements before they are incorporated into the software project.	Strength
Activity 2	The software engineering group uses the allocated requirements as the basis for software plans, work products, and activities.	The software engineering group uses the allocated requirements as the basis for software plans, work products, and activities.	Strength
Activity 3	Changes to the allocated requirements are reviewed and incorporated into the software project.	Changes to the allocated requirements are reviewed and incorporated into the software project.	Strength
Measurement 1	Measurements are made and used to determine the status of the activities for managing the allocated requirements.	Measurements are made and used to determine the status of the activities for managing the allocated requirements.	Strength
Verification 1	The activities for managing the allocated requirements are reviewed with senior management on a periodic basis.	Periodic meetings with senior management include reviews of allocated requirements.	Strength
Verification 2	The activities for managing the allocated requirements are reviewed with the project manager on both a periodic and event-driven basis.	The activities for managing the allocated requirements are reviewed with the project manager on both a periodic and event-driven basis.	Strength
Verification 3	The software quality assurance group reviews and/or audits the activities and work products for managing the allocated requirements and reports the results.	There is no software quality assurance group; therefore, no reviews and/or audits are done.	Weakness

Table III.2: Key Process Area: Software Project Planning

	Key practice	Finding	Rating
Commitment 1	A project software manager is designated to be responsible for negotiating commitments and developing the project's software development plan.	The NCAP project has a software manager designated to be responsible for negotiating commitments and developing the project's software development plan.	Strength
Commitment 2	The project follows a written organizational policy for planning a software project.	The project does not follow a written organizational policy for planning a software project.	Weakness
Ability 1	A documented and approved statement of work exists for the software project.	The approved project plan meets the requirements for a statement of work for the project.	Strength
Ability 2	Responsibilities for developing the software development plan are assigned.	The project manager has been assigned responsibility for developing the software development plan.	Strength
Ability 3	Adequate resources and funding are provided for planning the software project.	Adequate resources and funding have been provided for planning the software project.	Strength
Ability 4	The software managers, software engineers, and other individuals involved in the software project planning are trained in the software estimating and planning procedures applicable to their areas of responsibility.	Project personnel are not trained in software project planning and estimating procedures.	Weakness
Activity 1	The software engineering group participates on the project proposal team.	The software engineering group participates on the project proposal team.	Strength
Activity 2	Software project planning is initiated in the early stages of, and in parallel with, the overall project planning.	Software project planning is initiated in the early stages of, and in parallel with, the overall project planning.	Strength
Activity 3	The software engineering group participates with other affected groups in the overall project planning throughout the project's life.	The software engineering group participates with other affected groups in the overall project planning throughout the project's life.	Strength
Activity 4	Software project commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.	Software project commitments made to individuals and groups external to the organization are not reviewed with senior management and there is no documented procedure for such reviews.	Weakness
Activity 5	A software life-cycle with predefined stages of manageable size is identified or defined.	There is no documented evidence that a software life-cycle was selected for the project.	Weakness
Activity 6	The project's software development plan is developed according to a documented procedure.	The project has a software development plan that is developed according to a documented procedure.	Strength
Activity 7	The plan for the software project is documented.	The plan for the software project is documented in the project plan.	Strength
Activity 8	Software work products that are needed to establish and maintain control of the software project are identified.	Software work products that are needed to establish and maintain control of the software project are identified in the project plan.	Strength

(continued)

	Key practice	Finding	Rating
Activity 9	Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure.	Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure.	Strength
Activity 10	Estimates for the software project's effort and costs are derived according to a documented procedure.	Estimates for the software project's effort and costs are not derived according to a documented procedure.	Weakness
Activity 11	Estimates for the project's critical computer resources are derived according to a documented procedure.	Estimates for the project's critical computer resources are not derived according to a documented procedure.	Weakness
Activity 12	The project's software schedule is derived according to a documented procedure.	There is no documented procedure for deriving the software schedule.	Weakness
Activity 13	The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented.	The software risks associated with the cost, resource, schedule, and technical aspects of the project are identified, assessed, and documented.	Strength
Activity 14	Plans for the project's software engineering facilities and support tools are prepared.	Plans for the project's software engineering facilities and support tools are prepared.	Strength
Activity 15	Software planning data are recorded.	Software planning data are recorded.	Strength
Measurement 1	Measurements are made and used to determine the status of the software planning activities.	Measurements are made and used to determine the status of the software planning activities (status and MS Project reports).	Strength
Verification 1	The activities for software project planning are reviewed with senior management on a periodic basis.	The activities for software project planning are periodically reviewed with senior management, including reports to Treasury and Customs investment review board (IRB).	Strength
Verification 2	The activities for software project planning are reviewed with the project manager on both a periodic and event-driven basis.	The activities for software project planning are reviewed with the project manager on both a periodic and event-driven basis through weekly status reports and meetings.	Strength
Verification 3	The software quality assurance group reviews and/or audits the activities and work products for software project planning and reports the results.	There is no SQA group.	Weakness

Table III.3: Key Process Area: Software Project Tracking and Oversight

	Key practice	Finding	Rating
Commitment 1	A project software manager is designated to be responsible for the project's software activities and results.	The project software manager is designated to be responsible for the project's software activities and results.	Strength
Commitment 2	The project follows a written organizational policy for managing the software project.	There is no written organizational policy for managing the software project.	Weakness
Ability 1	A software development plan for the software project is documented and approved.	An approved and documented software development plan is contained in the project plan.	Strength
Ability 2	The project software manager explicitly assigns responsibility for software work products and activities.	The project software manager explicitly assigns responsibility for software work products and activities.	Strength
Ability 3	Adequate resources and funding are provided for tracking the software project.	Adequate resources and funding are provided for tracking the software project.	Strength
Ability 4	The software managers are trained in managing the technical and personnel aspects of the software project.	The software managers are not trained in managing the technical and personnel aspects of the software project.	Weakness
Ability 5	First-line software managers receive orientation in the technical aspects of the software project.	First-line software managers receive orientation in the technical aspects of the software project.	Strength
Activity 1	A documented software development plan is used for tracking the software activities and communicating status.	A documented software development plan is used for tracking the software activities and communicating status.	Strength
Activity 2	The project's software development plan is revised according to a documented procedure.	No documented procedure exists for revising the software development plan.	Weakness
Activity 3	Software project commitments and changes to commitments made to individuals and groups external to the organization are reviewed with senior management according to a documented procedure.	Software project commitments and changes to commitments made to individuals and groups external to the organization are not reviewed with senior management. Also, there is no documented procedure for such reviews.	Weakness
Activity 4	Approved changes to commitments that affect the software project are communicated to the members of the software engineering group and other software-related groups.	Approved changes to commitments that affect the software project are communicated to the members of the software engineering group and other software-related groups through weekly staff meetings.	Strength
Activity 5	The sizes of the software work products (or sizes of the changes to the software work products) are tracked, and corrective actions are taken as necessary.	The size of the software work products (or size of the changes to the software work products) are tracked; however, at the time of our evaluation, no corrective actions were needed.	Strength
Activity 6	The project's software effort and costs are tracked and corrective actions are taken as necessary.	The project's software effort and costs are tracked; however, at the time of our evaluation, no corrective actions were needed.	Strength

(continued)

	Key practice	Finding	Rating
Activity 7	The project's critical computer resources are tracked, and corrective actions are taken as necessary.	The project's critical computer resources are tracked; however, at the time of our evaluation, no corrective actions were needed.	Strength
Activity 8	The project's software schedule is tracked, and corrective actions are taken as necessary.	The project's software schedule is tracked; however, at the time of our evaluation, no corrective actions were needed.	Strength
Activity 9	Software engineering technical activities are tracked, and corrective actions are taken as necessary.	Software engineering technical activities are tracked, and corrective actions are taken as necessary.	Strength
Activity 10	The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked.	The software risks associated with cost, resource, schedule, and technical aspects of the project are tracked.	Strength
Activity 11	Actual measurement data and replanning data for the software project are recorded.	Actual measurement data and replanning data for the software project are recorded.	Strength
Activity 12	The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan.	The software engineering group conducts periodic internal reviews to track technical progress, plans, performance, and issues against the software development plan.	Strength
Activity 13	Formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure.	Formal reviews to address the accomplishments and results of the software project are conducted at selected project milestones according to a documented procedure.	Strength
Measurement 1	Measurements are made and used to determine the status of the software tracking and oversight activities.	Measurements are made and used to determine the status of the software tracking and oversight activities.	Strength
Verification 1	The activities for software project tracking and oversight are reviewed with senior management periodically.	The activities for software project tracking and oversight are reviewed with senior management on a weekly basis.	Strength
Verification 2	The activities for software project tracking and oversight are reviewed with the project manager on both a periodic and event-driven basis.	The activities for software project tracking and oversight are reviewed with the project manager on both a periodic and event-driven basis.	Strength
Verification 3	The software quality assurance group reviews and/or audits the activities and work products for software project tracking and oversight and reports the results.	No software quality assurance group exists; therefore, there are no reviews and/or audits of the activities and work products for software project tracking and oversight.	Weakness

Table III.4: Key Process Area: Software Quality Assurance

	Key practice	Finding	Rating
Commitment 1	The project follows a written organizational policy for implementing software quality assurance (SQA).	There is no written organizational policy for implementing SQA.	Weakness
Ability 1	A group that is responsible for coordinating and implementing SQA for the project (the SQA group) exists.	Although there is no group responsible for coordinating and implementing SQA for the project, there are plans to establish one and assign responsibility.	Observation
Ability 2	Adequate resources and funding are provided for performing the SQA activities.	There is no SQA group, and no resources and funding are provided for performing SQA activities.	Weakness
Ability 3	Members of the SQA group are trained to perform their SQA activities.	There is no SQA group or plan to provide SQA training.	Weakness
Ability 4	The members of the software project receive orientation on the role, responsibilities, authority, and value of the SQA group.	Project staff do not receive orientation on the role, responsibilities, authority, and value of the SQA group.	Weakness
Activity 1	The SQA plan is prepared for the software project according to a documented procedure.	There is no SQA plan or documented procedure for preparing one.	Weakness
Activity 2	The SQA group's activities are performed in accordance with the SQA plan.	There is no SQA group.	Weakness
Activity 3	The SQA group participates in the preparation and review of the project's software development plan, standards, and procedures.	There is no SQA group.	Weakness
Activity 4	The SQA group reviews the software engineering activities to verify compliance.	There is no SQA group.	Weakness
Activity 5	The SQA group audits designated software work products to verify compliance.	There is no SQA group.	Weakness
Activity 6	The SQA group periodically reports the results of its activities to the software engineering group.	There is no SQA group.	Weakness
Activity 7	Deviations identified in the software activities and software work products are documented and handled according to a documented procedure.	Procedures for handling deviations in testing activities are documented. However, procedures for handling deviations in other software development activities (such as compliance with organizational policy and standards and adherence to software development plan) are not documented.	Weakness
Activity 8	The SQA group conducts periodic reviews of its activities and findings with the customer's SQA personnel, as appropriate.	There is no SQA group.	Weakness
Measurement 1	Measurements are made and used to determine the cost and schedule status of the SQA activities.	There is no SQA group.	Weakness
Verification 1	The SQA activities are reviewed with senior management on a periodic basis.	There is no SQA group.	Weakness

(continued)

	Key practice	Finding	Rating
Verification 2	The SQA activities are reviewed with the project manager on both a periodic and event-driven basis.	There is no SQA group.	Weakness
Verification 3	Experts independent of the SQA group periodically review the activities and software work products of the project's SQA group.	There is no SQA group.	Weakness

Table III.5: Key Process Area: Software Configuration Management

	Key practice	Finding	Rating
Commitment 1	The project follows a written organizational policy for implementing software configuration management (SCM).	The project has no organizational policy for implementing SCM.	Weakness
Ability 1	A board having the authority for managing the project's software baselines (i.e., a software configuration control board) exists or is established.	The project does not have a SCM board with authority for managing software baselines.	Weakness
Ability 2	A group that is responsible for coordinating and implementing SCM for the project (i.e., the SCM group) exists.	The project does not have a group that is responsible for coordinating and implementing SCM functions.	Weakness
Ability 3	Adequate resources and funding are provided for performing the SCM activities.	Adequate resources and funding are not provided for performing the SCM activities.	Weakness
Ability 4	Members of the SCM group are trained in the objectives, procedures, and methods for performing their SCM activities.	There is no SCM group.	Weakness
Ability 5	Members of the software engineering group and other software-related groups are trained to perform their SCM activities.	Members of the software engineering group and other software-related groups are not trained to perform their SCM activities.	Weakness
Activity 1	A SCM plan is prepared for each software project according to a documented procedure.	A SCM plan was prepared according to procedures documented in the October 1996 SDLC.	Strength
Activity 2	A documented and approved SCM plan is used as the basis for performing the SCM activities.	The documented and approved SCM plan is used as the basis for performing code control; however, the plan is not used as a basis for doing SCM on software documentation and other software engineering products such as cost estimates and schedules.	Weakness
Activity 3	A configuration management library system is established as a repository for the software baselines.	A configuration management library system is established as a repository for the software baselines.	Strength
Activity 4	The software work products to be placed under configuration management are identified.	The software work products to be placed under configuration management are identified.	Strength
Activity 5	Change requests and problem reports for all configuration items/risks are initiated, recorded, reviewed, approved, and tracked according to a documented procedure.	Change requests and problem items/units are initiated, recorded, reviewed, approved, and tracked according to a procedure documented in the SCM plan.	Strength

(continued)

	Key practice	**Finding**	**Rating**
Activity 6	Changes to baselines are controlled according to a documented procedure.	Changes to baselines are controlled according to a documented procedure in the SCM plan.	Strength
Activity 7	Products from the software baseline library are created, and their release is controlled according to a documented procedure.	Products from the software baseline library are created, and their release is controlled according to the SCM plan.	Strength
Activity 8	The status of software configuration items/units is recorded according to a documented procedure.	The status of SCM items/units are not recorded according to a documented procedure.	Weakness
Activity 9	Standard reports documenting SCM activities and the contents of the software baseline are developed and made available to affected groups and individuals.	Standard reports documenting SCM activities and contents of the software baseline are not developed.	Weakness
Activity 10	Software baseline audits are conducted according to a documented procedure.	Software baseline audits are not conducted.	Weakness
Measurement 1	Measurements are made and used to determine the status of SCM activities.	No measurements are taken to determine the status of SCM activities.	Weakness
Verification 1	SCM activities are reviewed with senior management periodically.	SCM activities are not reviewed with senior management periodically.	Weakness
Verification 2	SCM activities are reviewed with the project manager on both a periodic and event-driven basis.	SCM activities are not reviewed with the project manager on both a periodic and event-driven basis.	Weakness
Verification 3	SCM group periodically audits software baselines to verify that they conform to the documentation that defines them.	No SCM audits are done to verify that software baselines conform to the documentation that defines them.	Weakness
Verification 4	The software quality assurance group reviews and/or audits the activities and work products for SCM and reports the results.	There is no quality assurance group; therefore, no one reviews and/or audits the activities and work products for SCM activities performed.	Weakness

Results of Software Acquisition Capability Maturity Model (SA-CMM) Evaluation for NCAP 0.2

Table IV.1: Key Process Area: Software Acquisition Planning

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for planning the software acquisition.	There is no written policy for planning the software acquisition.	Weakness
Commitment 2	Responsibility for software acquisition planning activities is designated.	Responsibility for software acquisition planning is not designated.	Weakness
Ability 1	The acquisition organization has experienced software acquisition management personnel.	The acquisition organization does not have experienced software acquisition management personnel.	Weakness
Ability 2	Adequate resources are provided for software acquisition planning activities.	Resources for software acquisition planning are not adequate.	Weakness
Activity 1	Software acquisition planning personnel are involved in system acquisition planning.	Software acquisition planning personnel are not involved in system acquisition planning.	Weakness
Activity 2	The software acquisition strategy for the project is developed and documented.	A software acquisition strategy for NCAP 0.2 was not developed and documented.	Weakness
Activity 3	The project's software acquisition planning is documented, and the planning documentation is maintained over the life of the project.	Software acquisition planning for NCAP 0.2 has not been documented.	Weakness
Activity 4	Life-cycle support of the software is included in software acquisition planning documentation.	Life-cycle support of the software has not been included in any document.	Weakness
Activity 5	Life-cycle cost and schedule estimates for the software products and services being acquired are prepared and independently reviewed.	Life-cycle cost and schedule estimates were prepared, but there is no evidence that they were independently reviewed.	Observation
Measurement 1	Measurements are made and used to determine the status of the software acquisition planning activities and resultant products.	Software acquisition planning activities are not measured.	Weakness
Verification 1	Software acquisition planning activities are reviewed by acquisition organization management periodically.	Software acquisition planning activities are not reviewed by management.	Weakness
Verification 2	Software acquisition planning activities are reviewed by the project manager on both a periodic and event-driven basis.	There is no documented evidence that the project manager reviewed software acquisition planning activities.	Weakness

Table IV.2: Key Process Area: Solicitation

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for the conduct of the software portion of the solicitation.	There is no written policy for the conduct of the software portion of the solicitation.	Weakness
Commitment 2	Responsibility for the software portion of the solicitation is designated.	Responsibility for the software portion of the solicitation was designated to the project manager/contract officer's technical representative (COTR).	Strength
Commitment 3	A selection official has been designated to be responsible for the selection process and the decision.	A selection official has been designated.	Strength
Ability 1	A group that is responsible for coordinating and conducting solicitation activities exists.	There is no documented evidence that a group responsible for coordinating and conducting solicitation activities exists.	Weakness
Ability 2	Adequate resources are provided for solicitation activities.	Resources for solicitation activities are not adequate.	Weakness
Ability 3	Individuals performing solicitation activities have experience or receive training.	There is only one individual performing solicitation activities. Although he was trained as a COTR, he has no experience or training in acquisition management or costing methodologies and tools.	Weakness
Ability 4	The groups supporting the solicitation (e.g., end user, systems engineering, software support organization, and application domain experts) receive orientation on the solicitation's objectives and procedures.	No orientation is provided to any other groups. End users, system engineers, and software support organizations did not participate in the solicitation.	Weakness
Activity 1	The project team performs its activities in accordance with its documented solicitation plans.	There are no documented solicitation plans to guide the performance of solicitation activities.	Weakness
Activity 2	The project team performs its activities in accordance with its documented proposal evaluation plans.	There are no documented proposal evaluation plans.	Weakness
Activity 3	Cost and schedule estimates for the software products and services being sought are prepared.	Cost and schedule estimates for the software products and services being sought are prepared.	Strength
Activity 4	Software cost and schedule estimates are independently reviewed for comprehensiveness and realism.	Software cost and schedule estimates are not independently reviewed.	Weakness
Activity 5	The project team takes action to ensure the mutual understanding of software requirements and plans prior to contract award.	The project team takes action to ensure the mutual understanding of software requirements and plans prior to contract award.	Strength
Measurement 1	Measurements are made and used to determine the status of the solicitation activities and resultant products.	No measurements were made to determine the status of solicitation activities and resultant products.	Weakness
Verification 1	Solicitation activities are reviewed periodically by the designated selection official or acquisition organization management.	Solicitation activities were not reviewed by the designated selection official or acquisition organization management on a periodic basis.	Weakness
Verification 2	Solicitation activities are reviewed by the project manager on both a periodic and event-driven basis.	Solicitation activities are not reviewed by the project manager on both a periodic and event-driven basis.	Weakness

Table IV.3: Key Process Area: Requirements Development and Management

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for establishing and managing the software-related contractual requirements.	There is no written policy for establishing and managing the software-related contractual requirements.	Weakness
Commitment 2	Responsibility for requirements development and management is designated.	Responsibility for requirements development and management is designated to the Process Analysis and Requirements Team (PART).	Strength
Ability 1	A group that is responsible for performing requirements development and management activities exists.	The PART team is responsible for performing requirements development and management.	Strength
Ability 2	Adequate resources are provided for requirements development and management activities.	The PART team has adequate resources for requirements development and management activities.	Strength
Ability 3	Individuals performing requirements development and management activities have experience or receive training.	Individuals performing requirements development and management activities have experience or receive training.	Strength
Activity 1	The project team performs its activities in accordance with its documented requirements development and management plans.	There are no documented requirements development and management plans.	Weakness
Activity 2	The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of the solicitation package.	The project team develops and baselines the software-related contractual requirements and places them under change control early in the project, but not later than release of the solicitation package.	Strength
Activity 3	The project team appraises system requirements change requests for their impact on the software being acquired.	To date there have been no system requirements change requests.	Observation
Activity 4	The project team appraises all changes to the software-related contractual requirements for their impact on performance, architecture, supportability, system resource utilization, and contract schedule and cost.	To date there have been no changes to the software-related contractual requirements.	Observation
Activity 5	Bidirectional traceability between the software-related contractual requirements and the contractor's software work products and services is maintained throughout the effort.	Bidirectional traceability between the software-related contractual requirements and the contractor's software work products and services is not maintained throughout the effort.	Weakness
Measurement 1	Measurements are made and used to determine the status of the requirements development and management activities and resultant products.	Measurements are made and used to determine the status of the requirements development and management activities and resultant products.	Strength
Verification 1	Requirements development and management activities are reviewed periodically by acquisition organization management (and the contractor).	Requirements development and management activities are reviewed periodically by acquisition management (and the contractor).	Strength
Verification 2	Requirements development and management activities are reviewed by the project manager on both a periodic and event-driven basis.	Requirements development and management activities are not reviewed by the project manager.	Weakness

Table IV.4: Key Process Area: Project Management

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for execution of the software project.	There is no written policy for execution of the software project.	Weakness
Commitment 2	Responsibility for project management is designated.	Responsibility for project management has been designated.	Strength
Ability 1	A team that is responsible for performing the project's software acquisition management activities exists.	A team that is responsible for performing the project's software acquisition management activities exists.	Strength
Ability 2	Adequate resources for the project team and matrix support persons are provided for the duration of the software acquisition project.	Adequate resources for the project team and matrix support persons are not provided for the duration of the software acquisition project.	Weakness
Ability 3	When project trade-offs are necessary, the project manager is permitted to alter either the performance, cost, or schedule software acquisition baseline.	The project manager, who is also the contracting officer's technical representative, is permitted to alter either the performance, cost, or schedule software acquisition baseline.	Strength
Ability 4	The project team and matrix support individual(s) have experience or receive training in project software acquisition management activities.	The project team members do not have experience and have not received training in project software acquisition management activities.	Weakness
Activity 1	The project team performs its activities in accordance with its documented software acquisition management plans.	There is no software acquisition management plan; therefore, the project team does not perform its activities in accordance with a plan.	Weakness
Activity 2	The organization of the project provides for the management of all project functions.	The organization of the project does not provide for the management of all the project's functions. For example, acquisition planning and risk management are not provided.	Weakness.
Activity 3	The software acquisition management activities of the project team are directed to accomplish the project's objectives.	The software acquisition management activities of the project team are not directed to accomplish the project's objectives.	Weakness
Activity 4	The software acquisition management activities of the project team are controlled.	The activities of the project team are not controlled.	Weakness.
Activity 5	The project team implements a corrective action system for the identification, recording, tracking, and correction of problems discovered during the software acquisition.	There is no corrective action system for the identification, recording, tracking, and correction of problems discovered during the software acquisition.	Weakness
Activity 6	The project team tracks project status, execution, funding, and expenditures and takes action.	The project team tracks project status, execution, funding, and expenditures. At the time of our evaluation, however, no actions were needed.	Observation
Measurement 1	Measurements are made and used to determine the status of the project management activities and resultant products.	Measurements are taken and used to determine the status of project management activities and resultant products.	Strength
Verification 1	Project management activities are reviewed by acquisition organization management periodically.	Project management activities are not reviewed by acquisition organization management periodically.	Weakness
Verification 2	Project management activities are reviewed by the project manager on both a periodic and event-driven basis.	There was no evidence provided to show that the project management activities are reviewed by the project manager.	Weakness

Table IV.5: Key Process Area: Contract Tracking and Oversight Findings

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for the contract tracking and oversight of the contracted software effort.	There is no organizational policy for the contract tracking and oversight of the contracted software.	Weakness
Commitment 2	Responsibility for contract tracking and oversight activities is designated.	Responsibility for contract tracking and oversight has been designated to the project manager/COTR.	Strength
Commitment 3	The project team is supported by contracting specialists in the execution of the contract.	The contracting officer supports the project team in the execution of the contract.	Strength
Ability 1	A group that is responsible for managing contract tracking and oversight activities exists.	The project team is responsible for contract tracking and oversight activities.	Strength
Ability 2	Adequate resources are provided for contract tracking and oversight activities.	Adequate resources are not provided for contract tracking and oversight activities.	Weakness
Ability 3	Individuals performing contract tracking and oversight activities have experience or receive training.	The project manager has received training conducting his duties as a COTR.	Strength
Activity 1	The project team performs its activities in accordance with its documented contract tracking and oversight plans.	There is no contract tracking and oversight plan.	Weakness
Activity 2	The project team reviews required contractor software planning documents which, when satisfactory, are used to oversee the contractor's software engineering effort.	The contractor was not required to submit any software planning documents that could be used to oversee the contractor's software engineering effort.	Weakness
Activity 3	The project team conducts periodic reviews and interchanges with the contractor.	The project team conducts periodic reviews and interchanges with the contractor.	Strength
Activity 4	The project team reviews and tracks the development of the software engineering environment required to provide life-cycle support for the acquired software.	Customs provided the software engineering environment to the contractor; therefore, there was no need to track the development of the software engineering environment required to provide life-cycle support for the acquired software.	Not rated
Activity 5	Any problems or issues found by the project team during contract tracking and oversight are recorded in the appropriate corrective action system and tracked to closure.	Problems or issues found by the project team during contract tracking and oversight are not tracked.	Weakness
Activity 6	The project team maintains the integrity of the contract throughout the contract performance period.	The project team maintains the integrity of the contract throughout the contract performance period.	Strength
Measurement 1	Measurements are made and used to determine the status of the contract tracking and oversight activities and resultant products.	Measurement are not made to determine the status of contract tracking and oversight activities and resultant products.	Weakness
Verification 1	Contract tracking and oversight activities are reviewed by acquisition organization management periodically.	Contract tracking and oversight activities are not reviewed by the acquisition organization management.	Weakness
Verification 2	Contract tracking and oversight activities are reviewed by the project manager on both a periodic and event-driven basis.	Contract tracking and oversight activities are not reviewed by the project manager.	Weakness

Table IV.6: Key Process Area: Evaluation

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for managing the evaluation of the acquired software products and services.	There is no written policy for managing the evaluation of the acquired software products and services.	Weakness
Commitment 2	Responsibility for evaluation activities is clearly designated.	Responsibility for evaluation activities is clearly designated.	Strength
Ability 1	A group that is responsible for planning, managing, and performing evaluation activities for the project exists.	A group that is responsible for planning, managing, and performing evaluation activities for the project exists.	Strength
Ability 2	Adequate resources are provided for evaluation activities.	We found no evidence that a lack of resources precluded the performance of evaluation activities.	Observation
Ability 3	Individuals performing evaluation activities have experience or receive training.	Individuals performing evaluation activities have experience or receive training.	Strength
Ability 4	Members of the project team and groups supporting the software acquisition receive orientation on the objectives of the evaluation approach.	No orientation is provided to members of the project team and groups supporting the software acquisition.	Weakness
Activity 1	The project team performs its activities in accordance with its documented evaluation plans.	There are no documented evaluation plans.	Weakness
Activity 2	The project's evaluation requirements are developed in conjunction with the development of the system or software technical requirements.	The project's evaluation requirements are not developed in conjunction with the development of the system or software technical requirements.	Weakness
Activity 3	The evaluation requirements are incorporated into the solicitation package and resulting contract.	Some evaluation requirements have been incorporated into the solicitation package and resulting contract. Others, such as a mechanism that provides the project team visibility into the contractor's evaluation program and requirements for the contractor to establish a corrective action system, have not.	Weakness
Activity 4	The project team assesses contractor's performance for compliance with evaluation requirements.	The project team does not assess the contractor's performance for compliance with evaluation requirements.	Weakness
Activity 5	Planned evaluations are performed on the acquired software products and services prior to acceptance for operational use.	No products or services have yet been accepted for operational use. The project team plans to evaluate acquired software products and services prior to acceptance for operational use.	Observation
Activity 6	Results of the evaluations are analyzed and compared to the contract's requirements to establish an objective basis to support the decision to accept the products and services or to take further action.	No products or services have yet been delivered by the contractor. The project team plans to analyze the results of the evaluations and compare the results to contract requirements as an objective basis to support the decision to accept the products and services or to take further action.	Observation

(continued)

	Key practice	**Finding**	**Rating**
Measurement 1	Measurements are made and used to determine the status of the evaluation activities and resultant products.	No measurements are made to determine the status of evaluation activities and resultant products.	Weakness
Verification 1	Evaluation activities are reviewed by acquisition organization management periodically.	Evaluation activities are not reviewed by acquisition organization management.	Weakness
Verification 2	Evaluation activities are reviewed by the project manager on both a periodic and event-driven basis.	Evaluation activities are not reviewed by the project manager.	Weakness

Table IV.7: Key Process Area: Transition to Support

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for transitioning software products to the software support organization.	There is no policy for the transitioning of software products to the software support organization.	Weakness
Commitment 2	The acquisition organization ensures that the software support organization is involved in planning for transition to support.	A software support organization has not been established.	Weakness
Commitment 3	Responsibility for transition to support activities is designated.	Responsibility for transition to support activities has not been designated.	Weakness
Ability 1	A group that is responsible for coordinating the transition to support activities exists.	No group is responsible for coordinating transition to support activities.	Weakness
Ability 2	Adequate resources are provided for transition to support activities.	Adequate resources have not been provided for transition to support activities.	Weakness
Ability 3	The organization responsible for providing support of the software products is identified no later than initiation of the solicitation package's development.	The organization responsible for providing support of the software products was not identified before initiation of the solicitation package's development.	Weakness
Ability 4	The software support organization, prior to transition, has a complete inventory of all software and related items that are to be transitioned.	At the time of the audit, the system was still in development and had not reached the transition stage.	Not rated
Ability 5	Individuals performing transition to support activities have experience or receive training.	Individuals responsible for transition to support activities have not been selected.	Weakness
Ability 6	The members of organizations interfacing with the transition to support activities receive orientation on the salient aspects of transition to support activities.	The members of organizations interfacing with the transition to support activities have not received orientation on the salient aspects of transition to support activities.	Weakness
Activity 1	The project team performs its activities in accordance with its documented transition to support plans.	There are no transition to support plans.	Weakness
Activity 2	Responsibility for the software products is transferred only after the software support organization demonstrates its capability to modify and support the software products.	No products have been transferred yet.	Not rated
Activity 3	The project team oversees the configuration control of the software products throughout the transition.	Transition has not yet occurred.	Not rated
Measurement 1	Measurements are made and used to determine the status of the transition to support activities and resultant products.	There are no plans to take measurements to determine the status of the transition to support activities and resultant products.	Weakness
Verification 1	Transition to support activities are reviewed by acquisition and software support organizations' managements periodically.	There are no plans for acquisition and software support organizations' managements to review transition to support activities periodically.	Weakness
Verification 2	Transition to support activities are reviewed by the project manager on both a periodic and event-driven basis.	No evidence was provided that transition to support activities are reviewed by the project manager.	Weakness

Table IV.8: Key Process Area: Acquisition Risk Management

	Key practice	Finding	Rating
Commitment 1	The acquisition organization has a written policy for the management of software acquisition risk.	There is no policy for the management of software acquisition risk.	Weakness
Commitment 2	Responsibility for software acquisition risk management activities is designated.	Responsibility for software acquisition risk management activities is not designated.	Weakness
Ability 1	A group that is responsible for coordinating software acquisition risk management activities exists.	No group responsible for coordinating software acquisition risk management activities exists.	Weakness
Ability 2	Adequate resources are provided for software acquisition risk management activities.	Adequate resources are not provided for software acquisition risk management activities.	Weakness
Ability 3	Individuals performing software acquisition risk management activities have experience or receive required training.	No individual or group is performing software acquisition risk management.	Weakness
Activity 1	Software acquisition risk management activities are integrated into software acquisition planning.	Software acquisition risk management activities are not integrated into software acquisition planning.	Weakness
Activity 2	The software acquisition risk management plan is developed in accordance with the project's defined software acquisition process.	There is no software acquisition risk management plan.	Weakness
Activity 3	The project team performs its software acquisition risk management activities in accordance with its documented plans.	No documented software acquisition risk management plans exists. No risk management activities are being performed.	Weakness
Activity 4	Risk management is conducted as an integral part of the solicitation, project performance management, and contract performance management processes.	Risk management is not conducted as an integral part of the solicitation, project performance management, and contract performance management processes.	Weakness
Activity 5	Software acquisition risk handling actions are tracked and controlled until the risks are mitigated.	There is no record of tracking and controlling software acquisition risk handling actions.	Weakness
Measurement 1	Measurements are made and used to determine the status of the acquisition risk management activities and resultant products.	Measurements are not made and used to determine the status of the acquisition risk management activities and resultant products.	Weakness
Verification 1	Acquisition risk management activities are reviewed by acquisition organization management periodically.	There are no acquisition risk management activities for management to review.	Weakness
Verification 2	Acquisition risk management activities are reviewed by the project manager on both a periodic and event-driven basis.	There are no acquisition risk management activities for the project manager to review.	Weakness

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