

October 2010

DOD BUSINESS TRANSFORMATION

Improved Management Oversight of Business System Modernization Efforts Needed



GAO

Accountability * Integrity * Reliability

Why GAO Did This Study

The Department of Defense (DOD) invests billions of dollars annually to modernize its business systems, which have been on GAO's high-risk list since 1995. DOD is in the process of implementing nine enterprise resource planning (ERP) efforts which perform business-related tasks such as general ledger accounting and supply chain management. These efforts are essential to transforming DOD's business operations. GAO was asked to (1) provide the status of the ERPs as of December 31, 2009; (2) determine whether selected ERPs followed schedule and cost best practices; and (3) determine if DOD has defined the performance measures to assess whether the ERPs will meet their intended business capabilities. To accomplish these objectives, GAO reviewed data on the status of each ERP from the program management officers and interviewed the DOD and military departments' chief management officers.

What GAO Recommends

In addition to reiterating its existing recommendations, GAO is making eight recommendations to the Secretary of Defense aimed at improving schedule and cost practices and the development of performance measures to evaluate whether the ERPs' intended goals are being accomplished. DOD concurred with our recommendations and plans to take action to implement them.

[View GAO-11-53 or key components.](#)

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What GAO Found

Based upon the data provided by DOD, six of the nine ERPs have experienced schedule delays ranging from 2 to 12 years and five have incurred cost increases ranging from \$530 million to \$2.4 billion. DOD has stated that the ERPs will replace over 500 legacy systems that cost hundreds of millions of dollars to operate annually. However, delays in implementing the ERPs require DOD to fund the legacy systems longer than anticipated, thereby reducing the funds available for other DOD priorities. In 2007, 2008, and 2009, GAO made 19 recommendations to improve the management of DOD's ERP efforts. While DOD agreed with the recommendations, 14 have not yet been fully implemented.

GAO analyzed four of the nine ERPs to determine whether scheduling and cost estimating best practices were being followed. Regarding scheduling practices, GAO found that none of the programs had developed a fully integrated master schedule as an effective tool to help in the management of the programs. A reliable schedule is crucial to estimating the overall schedule and cost of a program. Without a reliable schedule, DOD is unable to predict, with any degree of confidence, if the estimated completion dates are realistic. Regarding the cost estimates, GAO found that although the four ERPs' cost estimates generally met the criteria for three of the four best practices—well-documented, accurate, and comprehensive—three ERPs did not fully meet the credibility criteria because potential limitations were not discussed. More specifically, the three ERPs lacked a sensitivity analysis or a risk and uncertainty analysis as stipulated in GAO, Office of Management and Budget, and DOD guidance, thus diminishing the credibility of the estimates.

While the ERPs are critical to transforming DOD's business operations, DOD lacks a comprehensive set of performance measures to assess these systems and their contribution to transforming business operations. Management needs to define what constitutes a successful implementation in terms that can be used to assess whether the system is (1) being used as expected and (2) providing the intended benefits. Accordingly, the actual measures used to accomplish these objectives will differ depending on the system. For example, measures for a logistical system may focus on reducing inventory levels, while those for a financial system may focus on reducing prompt payment penalties. Without performance measures to evaluate how well the ERPs are accomplishing their intended goals, DOD decision makers do not have all the information they need to determine whether DOD investments are accomplishing their desired goals, and program managers do not have the information they need to ensure that their individual program is helping DOD to achieve business transformation and thereby improve upon its primary mission of supporting the warfighter.

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Abbreviations

ATEC	Army Test and Evaluation Command
BPR	business process reengineering
BSM	Business System Modernization

BTA	Business Transformation Agency
CARD	Cost Analysis Requirements Document
COTS	commercial off-the-shelf
DAI	Defense Agencies Initiative
DBSMC	Defense Business Systems Management Committee
DCMO	deputy chief management officer
DEAMS	Defense Enterprise Accounting and Management System
DID	Data Item Description
DIMHRS	Defense Integrated Military Human Resources System
DLA	Defense Logistics Agency
DOD	Department of Defense
EBS	Enterprise Business System
ECSS	Expeditionary Combat Support System
ERAM	Enterprise Risk Assessment Methodology
ERP	enterprise resource planning
EVM	earned value management
FFP	firm-fixed price
GCSS-Army	Global Combat Support System-Army
GCSS-MC	Global Combat Support System-Marine Corps
GFEBs	General Fund Enterprise Business System
IMS	integrated master schedule
IOT&E	initial operational test and evaluation
IPPS-A	Integrated Personnel and Pay System-Army
IRB	investment review board
IT	information technology
IUID	item-unique identification
IV&V	independent verification and validation
LMP	Logistics Modernization Program
MAIS	major automated information system
MDA	Milestone Decision Authority
MDAP	major defense acquisition program
MSO	Must Start On
NAVAIR	Naval Air Systems Command
Navy ERP	Navy Enterprise Resource Planning
NTC	National Training Center
OMB	Office of Management and Budget
PCA	pre-certification authority
PMO	program management office
RICE	reports, interfaces, conversions, and extensions
SFIS	Standard Financial Information Structure
TAV	total asset visibility

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United States Government Accountability Office
Washington, DC 20548

October 7, 2010

Congressional Requesters

The Department of Defense's (DOD) business systems¹ modernization program has been on our high-risk list² since 1995 because of the size, complexity, and significance of the related efforts. DOD's business systems modernization entails investments in and the implementation of comprehensive, integrated business systems for managing an organization's resources, commonly referred to as enterprise resource planning (ERP)³ systems and the elimination of hundreds of legacy systems. DOD officials have said that successful implementation of ERPs is key to resolving the long-standing weaknesses in the department's business operations in areas such as business transformation, financial management, and supply chain management,⁴ and improving the department's capability to provide DOD management and the Congress with accurate and reliable information on the results of its operations.

DOD has identified 10 ERPs,⁵ 1 of which has been fully implemented, as essential to its efforts to transform its business operations. According to DOD, as of December 2009, it had invested approximately \$5.8 billion to develop and implement these ERPs and will invest additional billions before the remaining 9 ERPs are fully implemented. Our prior reviews of several ERPs have found that the department has not effectively employed

¹DOD's business systems are information systems, including financial and nonfinancial systems that support DOD business operations, such as civilian personnel, finance, health, logistics, military personnel, procurement, and transportation.

²GAO, *High-Risk Series: An Update*, [GAO-09-271](#) (Washington, D.C.: January 2009).

³An ERP solution is an automated system using commercial off-the-shelf (COTS) software consisting of multiple, integrated functional modules that perform a variety of business-related tasks such as general ledger accounting, payroll, and supply chain management.

⁴These areas were designated as high risk in 2005, 1995, and 1990, respectively.

⁵The 10 ERPs are as follows: Army—General Fund Enterprise Business System (GFEBS), Global Combat Support System-Army (GCSS-Army), and Logistics Modernization Program (LMP); Navy—Navy Enterprise Resource Planning (Navy ERP) and Global Combat Support System-Marine Corps (GCSS-MC); Air Force—Defense Enterprise Accounting and Management System (DEAMS) and Expeditionary Combat Support System (ECSS); Defense—Service Specific Integrated Personnel and Pay Systems and Defense Agencies Initiative (DAI); and Defense Logistics Agency—Business System Modernization (BSM). According to DOD, BSM was fully implemented in July 2007.

acquisition management controls or delivered the promised capabilities on time and within budget.⁶

This report provides information to support your continuing oversight of DOD's progress in modernizing its business systems to address long-standing weaknesses and ultimately to transform its business operations. As agreed with your office, our objectives were to (1) provide the status as of December 31, 2009 of the nine ERPs DOD identified as essential to transforming its business operations, (2) assess the scheduling and cost estimating practices of selected ERPs to determine the extent to which the program management offices (PMO) were applying best practices, and (3) ascertain whether DOD and the military departments have defined the performance measures to determine whether the systems will meet their intended business capabilities.

To address the first objective, we reviewed status information obtained from each PMO, such as the reported amount of funds expended on the implementation of the nine ERPs, the estimated number of legacy systems to be replaced by each ERP, and the reported annual cost of maintaining these legacy systems. We also reviewed past GAO reports⁷ that were specific to the department's efforts to implement the nine ERPs to identify prior recommendations and assess DOD's progress in addressing the 19 recommendations discussed in these reports.

For the purposes of this report, we did not include information on the Defense Logistics Agency (DLA) Business System Modernization (BSM)/Enterprise Business System (EBS). According to DLA, the BSM effort was fully implemented in July 2007, and transformed how the agency conducts

⁶GAO, *Defense Logistics: Actions Needed to Improve Implementation of the Army Logistics Modernization Program*, [GAO-10-461](#) (Washington, D.C.: Apr. 30, 2010); *DOD Business Systems Modernization: Navy Implementing a Number of Key Management Controls on Enterprise Resource Planning System, but Improvements Still Needed*, [GAO-09-841](#) (Washington, D.C.: Sept. 15, 2009); *DOD Business Systems Modernization: Important Management Controls Being Implemented on Major Navy Program, but Improvements Needed in Key Areas*, [GAO-08-896](#) (Washington, D.C.: Sept. 8, 2008); *DOD Business Transformation: Air Force's Current Approach Increases Risk That Asset Visibility Goals and Transformation Priorities Will Not Be Achieved*, [GAO-08-866](#) (Washington, D.C.: Aug. 8, 2008); *DOD Business Systems Modernization: Key Marine Corps System Acquisition Needs to Be Better Justified, Defined, and Managed*, [GAO-08-822](#) (Washington, D.C.: July 28, 2008); and *DOD Business Transformation: Lack of an Integrated Strategy Puts the Army's Asset Visibility System Investments at Risk*, [GAO-07-860](#) (Washington, D.C.: July 27, 2007).

⁷[GAO-10-461](#), [GAO-09-841](#), [GAO-08-896](#), [GAO-08-866](#), [GAO-08-822](#), and [GAO-07-860](#).

its operations in five core business processes: order fulfillment, demand and supply planning, procurement, technical/quality assurance, and financial management. Subsequently, in September 2007, the name of the program was changed to the EBS, which is a continuation of the ERP's capabilities to support internal agency operations.

To address the second objective, we assessed the scheduling and cost estimating practices for four of the nine ERPs⁸ to determine the extent to which the PMOs were applying best practices for scheduling and cost estimating. For the four ERPs, we obtained and analyzed the most current schedule and cost estimate for each program and compared them against the criteria set forth in GAO's cost guide.⁹ In using the guide, we determined the extent to which the schedule was prepared in accordance with the best practices¹⁰ that are fundamental to having a reliable schedule. In assessing each program's cost estimates, we used the GAO cost guide to evaluate the PMOs' estimating methodologies, assumptions, and results to determine whether the cost estimates were comprehensive, accurate, well-documented, and credible. We did not conduct detailed schedule and cost assessments for the remaining five programs because (1) the implementation strategy has not been fully defined for two of the ERPs, (2) one of the ERPs is near full deployment, and (3) we have previously reported¹¹ on two ERPs' schedule and cost estimating practices.

To address the third objective, we reviewed the extent to which DOD and the military departments included performance measures in their congressional reports on business transformation. In addition, we met with the military departments' deputy chief management officers (DCMO) to obtain an understanding of how they define success in terms of deploying their respective ERPs. We also met with the DOD DCMO and the Director of the Business Transformation Agency (BTA) to obtain an understanding of their respective roles and responsibilities in the oversight of DOD's ERP implementation efforts. Additional details on our scope and methodology are presented in appendix I.

⁸We reviewed the Army's GFEBs and GCSS-Army and the Air Force's DEAMS and ECSS.

⁹GAO, *GAO Cost Estimating and Assessment Guide Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: March 2009).

¹⁰[GAO-09-3SP](#).

¹¹[GAO-08-822](#) and [GAO-08-896](#).

We conducted this performance audit from June 2009 through October 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. We requested comments on a draft of this report from the Secretary of Defense or his designee. We received written comments from the Deputy Chief Management Officer, which are reprinted in appendix II.

Background

DOD is one of the largest and most complex organizations in the world. In fiscal year 2009, DOD reported that its operations consisted of \$1.8 trillion in assets, \$2.2 trillion in liabilities, approximately 3.2 million military and civilian personnel—including active and reserve components—and disbursements of over \$947 billion.¹² Execution of these operations spans a wide range of defense organizations, including the military departments and their respective major commands and functional activities, large defense agencies and field activities, and various combatant and joint operational commands that are responsible for military operations for specific geographic regions or theaters of operation. To execute military operations, the department performs interrelated and interdependent business functions, including financial management, logistics management, health care management, and procurement. To support its business functions, DOD has reported that it relies on about 2,080 business systems,¹³ including accounting, acquisition, logistics, and personnel systems.

¹²The reported amounts are not audited. In November 2009, the DOD Inspector General reported that because of long-standing internal control weaknesses, DOD's annual financial statements, which included these reported amounts, were not accurate and reliable.

¹³DOD excludes from its business systems those designated as national security systems under Section 2222 (j) of Title 10, United States Code. National security systems are intelligence systems, cryptologic activities related to national security, military command and control systems, and equipment that is an integral part of a weapon or weapons system or is critical to the direct fulfillment of military or intelligence missions.

Funding of DOD's Business Systems

To fund its existing business systems environment, DOD requested for fiscal year 2011 nearly \$17.4 billion to operate, maintain, and modernize its reported 2,080 business systems (see fig. 1). Of this amount, about \$12.2 billion is for operations and maintenance and the remaining \$5.2 billion is for planned or ongoing DOD business systems development modernization efforts.

Figure 1: DOD’s Fiscal Year 2011 Business Systems Budget Request by DOD Components (Dollars in Thousands)

Component	Current services	Development/modernization	Total	Percent	10%	20%	30%	40%	50%
Army	\$3,031,957	\$1,768,150	\$4,800,107	27.7%					
Air Force	\$2,323,175	\$1,666,103	\$3,989,278	23.0%					
Navy	\$2,310,296	\$536,492	\$2,846,788	16.4%					
TRICARE Management Activity	\$1,403,434	\$403,857	\$1,807,291	10.4%					
Defense Logistics Agency	\$763,438	\$160,478	\$923,916	5.3%					
Defense Information Systems Agency	\$689,584	\$25,190	\$714,774	4.1%					
Defense Finance and Accounting Service	\$397,239	\$29,812	\$427,051	2.5%					
Defense Human Resources Activity	\$253,215	\$67,950	\$321,165	1.9%					
Transportation Command	\$186,370	\$101,973	\$288,343	1.7%					
Business Transformation Agency	\$53,332	\$145,190	\$198,522	1.2%					
Washington Headquarters Service	\$153,579	\$27,119	\$180,698	1.0%					
Missile Defense Agency	\$0	\$152,208	\$152,208	0.8%					
Defense Commissary Agency	\$117,861	\$3,616	\$121,477	0.7%					
Defense Contract Management Agency	\$103,391	\$13,933	\$117,324	0.7%					
Department of Defense Dependents Education	\$94,590	\$0	\$94,590	0.6%					
Office of the Secretary of Defense	\$29,755	\$49,098	\$78,853	0.5%					
Joint Chiefs of Staff	\$60,151	\$10,963	\$71,114	0.4%					
Other DOD components	\$180,479	\$23,104	\$203,583	1.2%					
Total	\$12,151,846	\$5,185,236	\$17,337,082	100%					

Source: GAO based upon fiscal year 2011 budget request data provided by DOD. This data has not been validated.

The Office of Management and Budget (OMB) requires that funds requested for information technology (IT) projects be classified as either “steady state” (or “current services” in DOD) or as “development/modernization.” Current services represents funds for

operating and maintaining systems at current levels (i.e., without major enhancements). The development modernization budget category represents funds for developing new IT systems or making major enhancements to existing systems. Some systems have both current services and development modernization funding. While current services are to be used for operating the system at various locations, development modernization funds are to be used for activities such as developing and expanding system functionality at existing locations and deploying the system to new locations. Generally, current services are financed through Operation and Maintenance appropriations, whereas development modernization funding can come from several or a combination of several appropriations, such as Research, Development, Test, and Evaluation; Procurement; or the Defense Working Capital Fund.

DOD's Acquisition System Framework

ERPs are developed within the defense acquisition system framework, which is intended to translate mission needs and requirements into stable, affordable, and well-managed acquisition programs.¹⁴ The defense acquisition system framework was updated in December 2008 and consists of five program life-cycle phases and three related milestone decision points which are described below.

- **Materiel solution analysis (previously concept refinement).** The purpose of this phase is to refine the initial system solution (concept) and create a strategy for acquiring the solution. A decision is made at the end of this phase (Milestone A) regarding whether to move to the next phase.
 - **Milestone A** authorizes acquisition of the program and permission to begin planning and development of the system technology.
- **Technology development.** The purpose of this phase is to determine the appropriate set of technologies to be integrated into the investment solution by iteratively assessing the viability of the various technologies while simultaneously refining user requirements. Once the technology has been demonstrated, a decision is made (Milestone B) whether to move to the next phase.
 - **Milestone B** authorizes product development of the program based on well-defined technology and a reasonable system design plan.
- **Engineering and manufacturing development (previously system development and demonstration).** The purpose of this phase is to

¹⁴DOD Directive 5000.01, *The Defense Acquisition System* (Nov. 20, 2007).

develop a system and demonstrate through developer testing that the system can function in its target environment. A decision is made at the end of this phase (Milestone C) whether to move to the next phase.

- **Milestone C** authorizes entry of the system into the production and deployment phase or into limited deployment in support of operational testing.
- **Production and deployment.** The purpose of this phase is to achieve an operational capability that satisfies the mission needs, as verified through independent operational test and evaluation, and to implement the system at all applicable locations.
- **Operations and support.** The purpose of this phase is to operationally sustain the system in the most cost-effective manner over its life cycle.

Overview of DOD Business Systems Investment Review Process

In 2005, DOD adopted a “tiered accountability” approach to improve control and accountability over the billions of dollars it invests annually in DOD business systems. Under this approach, executive leadership for the direction, oversight, and execution of DOD investments is the responsibility of several entities within DOD and its components. As indicated below, the investment control process begins at the component level and works its way up through a hierarchy of review and approval authorities, depending on the size and significance of the investment.¹⁵

- Defense Business Systems Management Committee (DBSMC) serves as the highest-ranking governance body for business systems modernization activities and approves funding request for investments costing more than \$1 million within the department.

¹⁵There are five tiers of business systems. Tier 1 systems include all large, expensive system programs classified as a major automated information system (MAIS) or a major defense acquisition program (MDAP) and subject to the most extensive statutory and regulatory reporting requirements. Tier 2 systems include those with modernization efforts of \$10 million or greater but that are not designated as MAIS or MDAP or programs that have been designated as investment review board programs of interest because of their effect on DOD transformation objectives. Tier 3 systems include those with modernization efforts that have anticipated costs greater than \$1 million but less than \$10 million. Tier 4 includes systems with development/modernization cost of \$1 million or less. Tier 5 includes systems in operation and maintenance or sustainment.

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- Investment review boards (IRB)¹⁶ are responsible for the review, approval, and oversight of the planning, design, acquisition, deployment, operation, maintenance, and modernization of defense business systems. The IRBs are also responsible for recommending business systems to the DBSMC for certification,¹⁷ which equates to recommending funding, for all business system investments costing more than \$1 million.
 - The Milestone Decision Authority (MDA) is the senior DOD official who has overall authority to approve entry of an acquisition program into the next phase of the acquisition process and is accountable for cost, schedule, and performance reporting, including congressional reporting.
 - DOD Component Acquisition Executive is responsible for providing a written memorandum to the MDA through the cognizant IRB that (1) states that the program complies with applicable DOD statutory and regulatory requirements, (2) describes any conditions or issues applicable to the requested acquisition decision, and (3) recommends approval of the acquisition decision request.

¹⁶The five IRBs are (1) financial management established by the Under Secretary of Defense (Comptroller); (2) weapon systems life-cycle management and materiel supply and services management established by the Under Secretary of Defense (Acquisition, Technology and Logistics); (3) real property and installations life-cycle management established by the Under Secretary of Defense (Acquisition, Technology and Logistics); (4) human resources management established by the Under Secretary of Defense for Personnel and Readiness; and (5) Department of Defense Chief Information Officer established by the Assistant Secretary of Defense (Networks and Information Integration)/DOD Chief Information Officer.

¹⁷Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Pub. L. No. 108-375, § 332, 118 Stat. 1811, 1851-1856 (Oct. 28, 2004), *codified in part at* 10 U.S.C. § 2222, directs that DOD may not obligate appropriated funds for a defense business system modernization with a total cost of more than \$1 million unless, the approval authority—that is the appropriate IRB—certifies that the business system modernization either (1) complies with the department’s business enterprise architecture, (2) is necessary to achieve a critical national security capability or address a critical requirement in an area such as safety or security, or (3) is necessary to prevent a significant adverse effect on an essential project in consideration of alternative solutions. This certification must also be approved by the DBSMC. Also, as of October 28, 2009, the fiscal year 2010 National Defense Authorization Act, Pub. L. No. 111-84, §1072, 123 Stat. 2190, 2470 (Oct. 28, 2009), amended this requirement. This amendment requires the chief management officer of the military services, or for defense agencies, the DOD DCMO, to assess whether (1) the business process that the system supports will be as streamlined and efficient as possible and (2) the need to tailor commercial-off-the-shelf systems to meet unique requirements or incorporate unique interfaces has been eliminated or reduced to the maximum extent practicable. This assessment is required both as a precondition of the approval of any new business system modernization with a cost over \$1 million, and as a review of any previously approved business system modernization with a cost over \$100 million.

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- A DOD component pre-certification authority (PCA) acts as the component's principle point of contact with the IRBs. The PCA is responsible for identifying the component's systems that require IRB certifications and prepares, reviews, approves, and validates investment documentation as required. The PCA also submits to the appropriate IRB the component's precertification memorandum that asserts the status and validity of the business system's investment information during the certification and annual review processes.

The MDA, IRBs, the DBSMC or a combination of these can place conditions or issues needing resolution upon the individual programs during the defense business system's funding certification and acquisition decision review processes. These conditions are generally noted in a memorandum. Further, DOD's business investment management system includes two types of reviews for business systems: certification and annual reviews. Certification reviews apply to modernization projects with total costs over \$1 million. These reviews focus on program alignment with the business enterprise architecture and must be completed before components obligate funds for programs. As noted above, the IRBs recommend certification to the DBSMC, which approves the expenditure of funds. The annual reviews apply to all business programs and are undertaken to determine whether the system development effort is meeting its milestones and addressing its certification conditions.

Additionally, the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 directs that the executive-level oversight of DOD-wide business systems modernization and overall business transformation—including defining and measuring success in enterprise resource planning—is the responsibility of a military department-level chief management officer and the DCMO.¹⁸

DOD's ERP Efforts

The department stated that the following nine ERPs are critical to transforming the department's business operations and addressing some of its long-standing weaknesses. A brief description of each ERP is presented below.

- The General Fund Enterprise Business System (GFEBS) is intended to support the Army's standardized financial management and accounting

¹⁸Pub. L. No. 110-417, div. A, title IX; §908, 122 Stat. 4356, 4569 (Oct. 14, 2008).

practices for the Army's general fund,¹⁹ with the exception of that related to the Army Corps of Engineers, which will continue to use its existing financial system, the Corps of Engineers Financial Management System.²⁰ GFEBS will allow the Army to share financial, asset and accounting data across the active Army, the Army National Guard, and the Army Reserve. The Army estimates that when fully implemented, GFEBS will be used to control and account for about \$140 billion in spending.

- The Global Combat Support System-Army (GCSS-Army) is expected to integrate multiple logistics functions by replacing numerous legacy systems and interfaces. The system will provide tactical units with a common authoritative source for financial and related non-financial data, such as information related to maintenance and transportation of equipment. The system is also intended to provide asset visibility for accountable items. GCSS-Army will manage over \$49 billion in annual spending by the active Army, National Guard, and the Army Reserve.
- The Logistics Modernization Program (LMP) is intended to provide order fulfillment, demand and supply planning, procurement, asset management, material maintenance, and financial management capabilities for the Army's working capital fund. The Army has estimated that LMP will be populated with 6 million Army-managed inventory items valued at about \$40 billion when it is fully implemented.
- The Navy Enterprise Resource Planning System (Navy ERP) is intended to standardize the acquisition, financial, program management, maintenance, plant and wholesale supply, and workforce management capabilities at six Navy commands.²¹ Once it is fully deployed, the Navy estimates that the system will control and account for approximately \$71 billion, or 50 percent, of the Navy's estimated appropriated funds—after excluding the appropriated funds for the Marine Corps and military personnel and pay.

¹⁹The general fund can be defined as the fund into which receipts are deposited, except those from specific sources required by law to be deposited into other designated funds and from which appropriations are made by Congress to carry on the general and ordinary operations of the government.

²⁰According to the GFEBS PMO, once the system is fully operational the Army will assess the feasibility of GFEBS becoming the system of record for the Corps of Engineers.

²¹The six Navy commands are the Naval Air Systems Command, the Naval Supply Systems Command, the Space and Naval Warfare Systems Command, the Naval Sea Systems Command, the Strategic Systems Program, and the Office of Naval Research and Strategic Systems Planning.

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- The Global Combat Support System–Marine Corps (GCSS-MC) is intended to provide the deployed warfighter enhanced capabilities in the areas of warehousing, distribution, logistical planning, depot maintenance, and improved asset visibility. According to the PMO, once the system is fully implemented, it will control and account for approximately \$1.2 billion of inventory.
 - The Defense Enterprise Accounting and Management System (DEAMS) is intended to provide the Air Force the entire spectrum of financial management capabilities, including collections, commitments and obligations, cost accounting, general ledger, funds control, receipts and acceptance, accounts payable and disbursement, billing, and financial reporting for the general fund. According to Air Force officials, when DEAMS is fully operational, it is expected to maintain control and accountability for about \$160 billion.
 - The Expeditionary Combat Support System (ECSS) is intended to provide the Air Force a single, integrated logistics system—including transportation, supply, maintenance and repair, engineering and acquisition—for both the Air Force’s general and working capital funds. Additionally, ECSS is intended to provide the financial management and accounting functions for the Air Force’s working capital fund operations. When fully implemented, ECSS is expected to control and account for about \$36 billion of inventory.
 - The Service Specific Integrated Personnel and Pay Systems are intended to provide the military departments an integrated personnel and pay system.²²
 - Defense Agencies Initiative (DAI) is intended to modernize the defense agencies’ financial management processes by streamlining financial management capabilities and transforming the budget, finance, and accounting operations. When DAI is fully implemented, it is expected to have the capability to control and account for all appropriated, working capital and revolving funds at the defense agencies implementing the system.

²²The military services integrated personnel and pay system is a replacement for the Defense Integrated Military Human Resources System that was intended to provide a joint, integrated, standardized personnel and pay system for all military personnel.

Status of DOD's ERP Implementation Efforts

Based upon the information provided by the PMOs, six of the ERPs have experienced schedule slippages (see table 1) based on comparing the estimated date that each program was originally scheduled to achieve full deployment²³ to the full deployment date as of December 2009. For the remaining three ERPs, the full deployment date has either remained unchanged or has not been established. The GFEBS PMO noted that the acquisition program baseline approved in November 2008, established a full deployment date in fiscal year 2011 and that date remains unchanged. Additionally, according to the GCSS-Army PMO a full deployment date has not been established for this effort. The PMO noted that a full deployment date will not be established for the program until a full deployment decision has been approved by the department. A specific timeframe has not been established for when the decision will be made. Further, in the case of DAI, the original full deployment date was scheduled for fiscal year 2012, but the PMO is in the process of reevaluating the date and a new date has not yet been established.

Table 1: Reported Full Deployment Schedule Slippage for Each ERP as of December 31, 2009

Component/system name	Originally scheduled fiscal year for full deployment	Actual or latest estimated fiscal year for full deployment	Schedule slippage
Army			
GFEBS	2011	2011	None
GCSS-Army	^a	^a	Not applicable
LMP	2005	2011	6 years
Navy			
Navy ERP	2011	2013	2 years
GCSS-MC	2010	2013	3 years ^b
Air Force			
DEAMS	2014	2017	3 years
ECSS	2012	2016	4 years

²³ Full deployment means with respect to a major automated information system program, the fielding of an increment of the program in accordance with the terms of a full deployment decision—the final decision made by the MDA authorizing an increment of the program to deploy software for operational use. Pub. L. No. 111-84, div. A, §841, 123 Stat. 2190, 2418 (Oct. 28, 2009), the National Defense Authorization Act for Fiscal Year 2010, directed that the terminology be changed from full operational capability to full deployment.

Component/system name	Originally scheduled fiscal year for full deployment	Actual or latest estimated fiscal year for full deployment	Schedule slippage
DOD			
Service Specific Integrated Personnel and Pay Systems	2006	Army—2014 Navy—2017 Air Force—2018	12 years ^c
DAI	2012	^d	Not applicable

Source: DOD program management offices.

^aThe PMO has not yet determined the full deployment date.

^bThe PMO stated that the estimated full deployment date is only for phase 1. The full deployment date for the entire program has not yet been determined.

^cOriginally, this ERP was referred to as the Defense Integrated Military Human Resources System (DIMHRS) and was intended to provide a joint, integrated, standardized personnel/pay system for all military personnel departmentwide. The original full deployment date represents the estimated date for DIMHRS. Each military service is now responsible for developing its own integrated personnel and pay system.

^dAs of December 2009, the DAI PMO had not determined the revised full deployment date.

Besides schedule slippages, five of the ERP efforts have reported a cost increase and one program—GFEBS—reported a cost decrease of \$17 million (see table 2). The reported life-cycle²⁴ cost estimate for GCSS-MC only represents the estimated cost for phase²⁵ 1 of the program. The cost of the remaining phases has not yet been determined and therefore, a total life-cycle cost estimate for the entire program has not been determined. Additionally, a current life-cycle cost estimate has not been determined for the Service Specific Integrated Personnel and Pay Systems and DAI.

²⁴A life-cycle cost estimate provides an accounting of all resources and associated cost elements required to develop, produce, deploy, and sustain a particular program. The life-cycle cost estimate encompasses all past, present, and future costs for every aspect of the program, regardless of funding source.

²⁵ERPs are developed in accordance with various models using terminology that varies among defense organizations and in some cases even within a given military service. For example, the Army’s GFEBS refers to a scheduled segment as a “release,” and within a release, there are “waves.” The Air Force’s DEAMS program refers to scheduled segments as “increments” and within increments, there are “spirals.” For the purposes of this report, we refer generally to scheduled segments of implementation as “phases.”

Table 2: Reported Original and Current Life-Cycle Cost Estimate for Each ERP as of December 31, 2009

Dollars in millions			
Component/system name	Original life-cycle cost estimate	Current life-cycle cost estimate	Reported cost increase
Army			
GFEBs	\$1,354	\$1,337	\$(17)
GCSS-Army	\$3,900	\$3,900	0
LMP	\$2,630	\$2,630 ^a	0
Navy			
Navy ERP	\$1,870	\$2,400	\$530
GCSS-MC	\$126	\$934	\$808 ^b
Air Force			
DEAMS	\$1,100	\$2,048	\$948
ECSS	\$3,000	\$5,200	\$2,200 ^c
DOD			
Service Specific Integrated Personnel and Pay Systems	\$577 ^d	Army ^d Navy-\$1,300 Air Force-\$1,700	At least \$2,423
DAI	\$209	^e	Not applicable

Source: DOD Program Management Offices.

^aAt the time LMP was designated as a major automated information system (MAIS) program in December 2007, it was required to comply with the DOD guidance for MAIS programs. This guidance requires, among other things, that a MAIS program have a completed and approved acquisition program baseline—the baseline description of the program, including the life-cycle cost estimate—prior to Milestone B approval. The \$2.6 billion is the only life-cycle cost estimate that has been developed for the program.

^bThe current life-cycle cost estimate for GCSS-MC is for phase one. The remaining two phases will have separate baselines.

^cOriginally, ECSS was to be implemented in three phases, but now, it will be implemented in four phases.

^dThe original life-cycle cost estimate represents the estimate for DIMHRS. While the Navy and Air Force have estimated their respective life-cycle cost estimate, the Army is in the process of completing its life-cycle cost estimate.

^eAs of December 2009, the life-cycle cost estimate for DAI had not been finalized. According to the PMO, the life-cycle cost estimate is expected to be approved at Milestone B in fiscal year 2011.

According to the PMOs, while there have been schedule slippages and cost increases, for several of the nine ERP efforts, the functionality that was envisioned and planned when each program was initiated remains the same today. While the original intent of each program remains the same, the anticipated savings that were to accrue to the department may not be

fully realized. Delays in implementing the ERPs result in DOD having to fund the operation and maintenance of the legacy systems longer than anticipated, thereby reducing funds that could be used for other DOD priorities.

Furthermore, we have previously reported on the department's effort in implementing some of the ERPs and made 19 recommendations to improve DOD's management and oversight of these efforts. As of October 2010, the department has taken sufficient action to implement 5 of the recommendations. Appendix III provides details on the specific recommendations and the department's efforts to address them. The following information describes in more detail the status of each ERP.

General Fund Enterprise Business System

DOD Program Data for GFEBS, as of December 31, 2009

Date of initiation: October 2004

Program owner: Assistant Secretary of the Army for Financial Management and Comptroller

Reported life-cycle cost estimate:

	\$1.336.7 billion
• Development and Modernization	\$ 642.4 million
• Operations and Maintenance	\$ 694.3 million

Reported amount expended: \$416.8 million

Reported legacy systems to be replaced: 87

Reported annual cost of maintaining legacy systems: \$57.8 million

Number of system interfaces: 56

Date of last certification of funding: September 2, 2009, by the DBSMC

Number of system users: 79,000

Number of locations: 200

Source: DOD's GFEBS Program Management Office. These data have not been validated.

Program Status

According to the GFEBS PMO, the system will be implemented in four phases. Phases 1 and 2 were completed in October 2008 and provided full

functionality to 250 users at the Management Command, Fort Jackson, South Carolina. The implementation of phase 2 set the stage for GFEBS to be deployed to the rest of the Army. The PMO currently estimates that phases 3 and 4 will be deployed Army-wide with full functionality by December 2011. PMO officials told us that the establishment of the December 2011 milestone resulted from conditions placed on the GFEBS program at Milestone B, directing the Army to develop an integrated strategy for the implementation of GFEBS and GCSS-Army—meaning that both systems were to be implemented using a standard configuration and set of common master data.²⁶ The PMO also stated that the original life-cycle cost estimate of approximately \$1.3 billion covering fiscal years 2005 through 2022 remained unchanged as of December 31, 2009.

On May 30, 2009, GFEBS was authorized by the MDA to proceed with a limited deployment to initial operational test and evaluation (IOT&E)²⁷ sites. In January 2010 and again in March 2010, the GFEBS program was authorized to continue its deployment to a limited number of sites. According to the MDA, this limited deployment process allows the program to gain additional operational experience with the GFEBS application and conduct additional user testing. MDA approval is required for deployment to additional sites and full deployment. Before GFEBS will be granted approval for full deployment of phase 4, the PMO must address several conditions²⁸ that were placed on the program by the MDA. According to the PMO, all of the conditions were addressed in December 2009 and presented to the IRB for approval. However, the decision on the deployment of the system to additional locations is pending and scheduled to occur during fiscal year 2010.

²⁶Master data are that persistent, non-transactional data that defines a business entity for which there is, or should be, an agreed upon view across the organization. This key business information may include data about customers, products, employees, materials, and suppliers. Master data are often used by several functional groups and stored in different data systems across an organization and may or may not be referenced centrally; therefore, the possibility exists for duplicate master data and/or inaccurate master data.

²⁷IOT&E are conducted on production or production-representative articles to determine whether systems are operationally effective and suitable.

²⁸Conditions or issues needing resolution may be placed upon the ERPs by the MDA, the IRB, or the DBSMC during the business system's funding certification and acquisition decision review milestone process. These conditions are generally noted in a memorandum.

In December 2009, the U.S. Army Test and Evaluation Command (ATEC) reported on concerns with GFEBS's data accuracy, reliability, and timeliness.²⁹ More specifically, the report noted that Army "installations certifying year-end data with caveats and notes related to inaccurate, incomplete, and missing data." Furthermore, the report noted that "because of incomplete or not implemented business processes, users at times, executed their mission using the "workarounds" of the legacy systems that the GFEBS is intended to replace or subsume." The report recommended that the deployment of GFEBS be limited until the problems are resolved and the corrective actions have been validated by ATEC. According to the PMO, in conjunction with ATEC, a plan of action and milestones has been developed to address the issues. The PMO noted that GFEBS is undergoing an additional operational test and evaluation limited user test; and at the conclusion of the testing, a determination will be made whether the ATEC issues have been addressed.

²⁹U.S. Army Test and Evaluation Command, *Operational Test Agency Evaluation Report for the General Fund Enterprise Business System* (Alexandria, Va.: Dec. 16, 2009).

Global Combat Support System-Army

DOD Program Data for GCSS-Army, as of December 31, 2009

Date of initiation: December 2003^a

Program owner: Army Deputy Chief of Staff for Logistics

Reported life-cycle cost estimate:

	\$3.9 billion
• Development and Modernization	\$1.8 billion
• Operations and Maintenance	\$2.1 billion

Reported amount expended: \$581 million

Reported legacy systems to be replaced: 7

Reported annual cost of maintaining legacy systems: \$63 million

Number of system interfaces: 106

Date of last certification of funding: September 2, 2009, by the DBSMC

Number of system users: 169,880

Number of locations: 379

Source: DOD's GCSS-Army Program Management Office. These data have not been validated.

^aPrior to the initiation of the current ERP effort, the Army had been developing custom software since May 1997.

Program Status

GCSS-Army is being implemented in three phases with phases 1 and 2 being proof-of-concept demonstrations that have been ongoing since December 2007 at the National Training Center (NTC) in Fort Irwin, California and testing and evaluation are scheduled to be completed in January 2012. The GCSS-Army team is conducting critical activities, such as data cleansing and training users at the NTC site. Phase 3 is intended to provide full functionality and is scheduled to begin implementation in October 2013, but a full deployment date has not yet been determined. According to the PMO, the exact locations for the implementation of phase 3 have not been determined because the deployment schedule by specific location has not yet been finalized.

In July 2008, the MDA, in approving Milestone B, directed GCSS-Army to develop and implement a strategy to better facilitate interactions with

GFEBs and LMP. Under the federated strategy, GCSS-Army will use GFEBs' financial template to allow the Army to integrate data on logistics, financial, maintenance, property, and accountability of assets. This strategy is intended to standardize transactional input and business processes across the Army ERPs to enable common cost management activities; provide accurate, reliable, and real-time data; and tie budgets to execution. According to the PMO, this change in implementation strategy resulted in

- the Cost Analysis Improvement Group's direction that an additional year of support be added to the cost estimate because of the additional time needed to deploy the system and
- a revised strategy that resulted in an increase in the number of required reports, interfaces, conversions, and extensions that need to be developed or tested for GCSS-Army's integration with GFEBs.

Logistics Modernization Program

DOD Program Data for LMP, as of December 31, 2009	
Date of initiation:	December 1999
Program owner:	Army Materiel Command
Reported life-cycle cost estimate:	\$2.630 billion
• Development and Modernization	\$ 637 million
• Operations and Maintenance	\$1.993 billion
Reported amount expended:	\$1.1 billion
Reported legacy systems to be replaced:	2
Reported annual cost of maintaining legacy systems:	\$25 million
Number of system interfaces:	27
Date of last certification of funding:	September 2, 2009, by the DBSMC
Number of system users:	21,000
Number of locations:	104

Source: DOD's LMP Program Management Office. These data have not been validated.

Program Status

LMP was deployed at the Army Communications-Electronics Command and Tobyhanna Army Depot in July 2003. In May 2009, the second deployment of LMP became operational at the Army Aviation and Missile Command and Corpus Christi and Letterkenny Army Depots. The final deployment of LMP is scheduled to occur in October 2010 at the Army Sustainment Command, the Joint Munitions and Lethality Command, the Tank-automotive and Armaments Command, and the Anniston and Red River Army Depots.

LMP has experienced schedule slippages primarily because requirements management³⁰ and system testing were ineffective which we reported on in May 2004³¹ and June 2005.³² For example, at the Tobyhanna Army Depot deployment in fiscal year 2003, customers were not being properly billed for work performed which affected the accurate recording of revenue, and account balances could not be reconciled when transferred from the legacy systems to LMP. As a result, the full deployment date of the system has slipped by 6 years.

Furthermore, in April 2010,³³ we reported that the Army's management processes for ensuring data reliability that were established prior to the second deployment of LMP were not effective. Specifically, the Army was unable to ensure that the data used by LMP were of sufficient quality to enable the depots to perform their day-to-day missions after LMP became operational. As a result of these data quality issues, depot personnel had to develop and use manual work-around processes until they could correct the data in LMP, which prevented the Army from achieving the expected benefits from LMP. Data quality issues occurred despite improvements made by the Army to address similar issues experienced during the first deployment of LMP because the Army's testing strategy did not provide

³⁰According to the Software Engineering Institute, requirements management is a process that establishes a common understanding between the customer and the software project manager regarding the customer's business needs that will be addressed by a project. A critical part of this process is to ensure that the requirement development portion of the effort documents, at a sufficient level of detail, the problems that need to be solved and the objectives that need to be achieved.

³¹GAO, *DOD Business Systems Modernization: Billions Continued to be Invested with Inadequate Management Oversight and Accountability*, [GAO-04-615](#) (Washington, D.C.: May 27, 2004).

³²GAO, *Army Depot Maintenance: Ineffective Oversight of Depot Maintenance Operations and System Implementation Efforts*, [GAO-05-441](#) (Washington, D.C.: June 30, 2005).

³³[GAO-10-461](#).

reasonable assurance that the data being used by LMP were accurate and reliable. We made recommendations to help improve the third deployment of LMP. We are following up on the Army's efforts to implement our recommendations and will report on those actions separately.

The PMO further noted that the original life-cycle cost estimate of approximately \$2.6 billion³⁴ covering fiscal years 2000 through 2021 remained unchanged as of December 2009. PMO officials told us that there were no issues or conditions that had been placed upon LMP by the MDA, IRBs or the DBSMC that needed to be resolved as of December 2009.

³⁴At the time LMP was designated as a MAIS program in December 2007, it was required to comply with the DOD guidance for MAIS programs. This guidance requires, among other things, that a MAIS program have a completed and approved acquisition program baseline—the baseline description of the program, including the life-cycle cost estimate—prior to Milestone B approval. The \$2.6 billion is the only life-cycle cost estimate that has been developed for the program.

Navy Enterprise Resource Planning System

DOD Program Data Provided for Navy ERP, as of December 31, 2009

Date of Initiation: July 2003

Program owner: Assistant Secretary of the Navy, Research, Development, and Acquisition

Reported life-cycle cost estimate: \$2.4 billion

- Development and Modernization \$1.0 billion
- Operations and Maintenance \$1.4 billion

Reported amount expended: \$691.3 million

Reported legacy systems to be replaced: 98

Reported annual cost of maintaining legacy systems: \$102 million

Number of system interfaces: 51

Date of last certification of funding: September 2, 2009, by the DBSMC

Number of system users: 66,000

Number of locations: 53

Source: DOD's Navy ERP Program Management Office. These data have not been validated.

Program Status

Navy ERP is to be implemented in two phases. As part of phase 1, the financial and acquisition functionalities of Navy ERP were deployed to the Naval Air Systems Command, Naval Supply Systems Command, and the Space and Naval Warfare Systems Command. Those functionalities are scheduled for deployment for the general fund at the Naval Sea Systems Command in October 2010 and the Navy Working Capital Fund in October 2011 and the Office of Naval Research and Strategic Systems Planning in October 2012. Phase 2 is currently in progress with the deployment of the wholesale and retail supply functionalities to the Navy. According to the PMO, Navy ERP is currently being used by 38,000 users and is executing approximately \$37 billion of the Navy's total obligational authority. Further, the PMO noted that in fiscal year 2010, 19 legacy systems have already been retired.

The Navy ERP implementation has experienced slippages of 2 years. Originally, the Navy ERP was to achieve full deployment in fiscal year

2011, but now full deployment is planned for fiscal year 2013. According to program documentation, these slippages occurred, in part, because of problems experienced in data conversion and adopting new business procedures associated with implementing the ERP. The delay occurred at the Naval Air Systems Command and affected the deployment schedule for the other locations. In addition to slippages in schedule, there have also been increases in the life-cycle cost estimate. The 2003 original life-cycle cost estimate for the Navy ERP was about \$1.87 billion. This estimate was later revised in August 2004, December 2006, and again in September 2007 to \$2.4 billion. According to the September 2007 acquisition program baseline, the estimated \$2.4 billion is for acquisition, operations, and support for fiscal years 2004 through 2023. Moreover, in September 2008,³⁵ we reported that not effectively implementing key IT management controls, such as earned value management, has contributed to the more than 2-year schedule delay and almost \$600 million cost overrun on the program since it began, and will likely contribute to future delays and overruns if not corrected.

The IRB has identified two issues or conditions that the Navy ERP PMO has to address: (1) provide a description of how the Navy plans to use the item-unique identification (IUID)³⁶ and (2) provide an updated checklist to BTA showing compliance with the Standard Financial Information Structure (SFIS).³⁷ The PMO stated that it presented a plan to the Navy Comptroller in February 2010 describing how it will use IUID and provided BTA the SFIS checklist in April 2010.

³⁵[GAO-08-896](#).

³⁶According to DOD, the purpose of the IUID is to facilitate asset accountability and tracking, including the identification and aggregation of related costs to derive the full cost of a contract deliverable.

³⁷BTA defines SFIS as a comprehensive “common business language” that supports information and data requirements for budgeting, financial accounting, cost/performance management, and external reporting across the DOD enterprise.

Global Combat Support System-Marine Corps

DOD Program Data for GCSS-MC, as of December 31, 2009

Date of Initiation: September 2003

Program owner: Assistant Secretary of the Navy, Research, Development, and Acquisition

Reported life-cycle cost estimate: \$934 million

- Development and Modernization \$489 million
- Operations and Maintenance \$445 million

Reported amount expended: \$245 million

Reported legacy systems to be replaced: 4

Reported annual cost of maintaining legacy systems: \$4.5 million

Number of system interfaces: 42

Date of last certification of funding: June 1, 2010 by the DBSMC

Number of system users: 33,000

Number of locations: 6

Source: DOD's GCSS-MC Program Management Office. These data have not been validated.

Program Status

GCSS-MC was authorized to "Go Live" for field user evaluation in March 2010 and Milestone C was granted in May 2010. GCSS-MC is to be implemented in three phases. Phase 1 is intended to provide a wide range of asset management capabilities such as planning inventory requirements to support current and future demands; requesting and tracking the status of products (e.g., supplies and personnel) and services (e.g., maintenance and engineering); allocating resources (e.g., inventory, warehouse capacity, and personnel) to support unit demands for specific products; and scheduling maintenance resources (e.g., manpower, equipment, and supplies) for specific assets, such as vehicles. Phases 2 and 3 are intended to provide additional functionality such as transportation and wholesale inventory management.

To date, there have been program slippages and cost increases. The PMO told us that full deployment for phase 1 was originally scheduled to be

achieved in November 2009. However, the current estimated full deployment date for phase 1 is January 2013.³⁸ GCSS-MC program officials informed us that the schedule slippage for phase 1 occurred incrementally over time during the design, build, and test phases of the program. The slippages occurred because of issues associated with system interfaces and the conversion of data from the legacy systems. Moreover, in July 2008,³⁹ we reported that not effectively implementing key IT management controls, such as economically justifying investment in the system, has in part contributed to a 3-year schedule slippage and about \$193 million cost overrun on the first phase of the program and will likely contribute to future delays and overruns if not corrected.

These schedule slippages caused the program to exceed the MAIS critical-breach criteria for time-certain development, which is the failure to achieve initial operating capability within 5 years of Milestone A approval. PMO officials also told us that initially, GCSS-MC had an estimated cost of approximately \$126 million over a 7-year life cycle.⁴⁰ This cost estimate was later revised in 2005 to approximately \$249 million over a 13-year life cycle.⁴¹ Currently, the PMO estimates the total life-cycle cost estimate for phase 1 to be approximately \$934 million. The total life-cycle cost estimate for the additional phases has not been determined. According to the PMO, phase 2 is in the preliminary planning stage and all additional phases will have separate acquisition program baselines.⁴² As a result, a total life-cycle cost estimate for the entire system may not be available for several years.

The IRB directed that the GCSS-MC PMO (1) provide a component-wide plan that addresses how GCSS-MC will include the capability to use IUID

³⁸ January 2013 is the estimated full deployment date in the proposed acquisition program baseline submitted for MDA approval in February 2010.

³⁹ [GAO-08-822](#).

⁴⁰ According to the May 10, 2004, analysis of alternatives, this estimate was a “rough order of magnitude” for research and development, procurement and operations and support from fiscal years 2004 through 2011.

⁴¹ According to the July 15, 2005, economic analysis, program costs are estimated from fiscal years 2005 through 2018, in base year 2005 dollars, and exclude \$9.6 million associated with supporting and maintaining legacy systems during GCSS-MC development and \$11.9 million in fiscal year 2004 sunk costs.

⁴² The acquisition program baseline is an important document for program management and should reflect the approved program being executed. In this regard, the acquisition program baseline formally documents the program’s estimated cost, schedule, and performance goals.

and (2) brief the Navy DCMO on the extent to which business process reengineering (BPR) has been performed to address the statutory requirement regarding BPR in Section 1072 of the Fiscal Year 2010 National Defense Authorization Act. In this regard, the act directs the Chief Management Officer to determine whether or not appropriate business process re-engineering efforts have been undertaken to ensure that (1) the business process to be supported by the business system will be as streamlined and efficient as practicable and (2) the need to tailor the ERP to meet unique requirements or incorporate unique interfaces has been eliminated. The PMO stated that it provided the BPR information to the Navy DCMO and the DCMO indicated that the PMO had addressed the requirements contained in the act.

Defense Enterprise Accounting and Management System

DOD Program Data for DEAMS, as of December 31, 2009

Date of initiation: August 2003

Program owner: Assistant Secretary of the Air Force for Financial Management and Comptroller

Reported life-cycle cost estimate:	\$2.048 billion
• Development and Modernization	\$1.030 billion
• Operations and Maintenance	\$1.018 billion

Reported amount expended: \$139.1 million

Reported legacy systems to be replaced: 10

Reported annual cost of maintaining legacy systems: \$55.9 million

Number of system interfaces: 100

Date of last certification of funding: December 14, 2009, by the DBSMC

Number of system users: 30,000

Number of locations: 179

Source: DOD's DEAMS Program Management Office. These data have not been validated.

Program Status

DEAMS will be deployed in three phases. Phase 1 deployed limited functionality—recording commitments—to about 650 system users at Scott Air Force Base in July 2007. According to the PMO, as part of phase

1, additional functionality was deployed to an additional 870 users in May 2010. Further, the PMO noted that DEAMS is currently scheduled to achieve initial operating capability for phase 2 for the U.S. Transportation Command and most of the Air Force's major commands in fiscal year 2014. According to the PMO, the final phase of DEAMS will be deployed to the remaining Air Force's major commands by fiscal year 2017, thereby providing the entire spectrum of general fund capabilities to the entire Air Force.

The Air Force expects DEAMS to reach full deployment in fiscal year 2017—which is a 3-year slippage from the full deployment date reported at program initiation. According to the PMO, DEAMS has experienced a 3-year schedule slippage because of problems caused by software code defects, integration test delays and to accommodate schedule risk. DEAMS program management officials acknowledged that the standardization of computer desktops across the Air Force contributed to schedule slippages. Our August 2008 report discussed this specific problem.⁴³

In addition to schedule slippages, DEAMS also had an increase in its life-cycle cost estimate. In August 2008, we reported that the Air Force's life-cycle cost estimate for DEAMS was about \$1.1 billion through fiscal year 2021.⁴⁴ According to the PMO, as of December 2009, the life-cycle cost estimate for the DEAMS is approximately \$2 billion through fiscal year 2027. The PMO stated that the increase in the life-cycle cost estimate can be attributed to changes in the program implementation strategy from two phases to three phases and program development and testing issues.

The IRB directed the DEAMS's PMO to (1) create an IUID compliance plan indicating when the system will include the capability to use IUID, (2) identify the date that one of the legacy systems will be subsumed, (3) provide a plan on how DEAMS will meet Environmental Liabilities Recognition Valuation and Reporting requirements, and (4) comply with Section 1072 of the National Defense Authorization Act for Fiscal Year 2010 related to business process reengineering. According to the PMO, the Air Force has addressed these issues.

⁴³ [GAO-08-866](#).

⁴⁴ [GAO-08-866](#).

Expeditionary Combat Support System

DOD Program Data for ECSS, as of December 31, 2009

Date of Initiation: January 2004

Program owner: Deputy Chief of Staff for Logistics, Installations, and Mission Support, Headquarters, U.S. Air Force

Reported life-cycle cost estimate:

• Development and Modernization	\$5.2 billion
• Operations and Maintenance	\$3.4 billion
	\$1.8 billion

Reported amount expended: \$518.9 million

Reported legacy systems to be replaced: 240

Reported annual cost of maintaining legacy systems: \$325 million

Number of system interfaces: 157 (phase 1) and 673 (phases 2, 3, and 4)

Date of last certification of funding: September 2, 2009, by the DBSMC

Number of system users: 250,000

Number of locations: 186

Source: DOD's ECSS Program Management Office. These data have not been validated.

Program Status

ECSS will be deployed in four phases. The Air Force anticipates that phase 1 will begin deployment in June 2012, with phase 2 scheduled for deployment in April 2014, phase 3 in January 2015, and phase 4 in November 2015. According to the PMO, each phase will provide additional functionality to the system users. Phase 1 will focus on base materiel and equipment management, phase 2 will concentrate on global materiel and equipment management and enterprise planning, phase 3 will involve depot maintenance repair and overhaul, and phase 4 will involve flight line maintenance and ammunition management. The PMO estimated that full deployment will be achieved in July 2016—a slippage of at least 4 years. According to the PMO, the slippage can be attributed to (1) two contract award protests—both denied by GAO—and (2) the change in the implementation strategy, which had originally called for the system to be

implemented in three phases. Also, in our August 2008 report,⁴⁵ we noted that the life-cycle cost estimate was approximately \$3 billion for the entire ECSS program when it was scheduled for three phases. According to the ECSS PMO, the current life-cycle cost estimate is approximately \$5.2 billion. Funding has not yet been approved for phases 2 through 4. The PMO noted that ECSS will seek approval at each phase's critical milestone in order to go forward to the next phase.

The Air Force DCMO told us that Air Force leadership (including the Secretary of the Air Force, Air Force Chief of Staff, and Senior Acquisition Executive) reviewed the program to determine whether it should be restructured or cancelled. The leadership was specifically concerned about the size, scope, and pace of the program. The program was restructured, and in June 2009, the decision was made to pursue only the revised phase 1 pending a demonstration of the program's ability to deliver to the revised schedule. The DCMO told us that the Air Force will make a decision on (1) whether to implement phase 1 and (2) whether to budget for the other phases in June 2010. According to the PMO, it anticipates the Air Force fully funding phase 1 and the long-lead requirements for phase 2 in the fiscal year 2012 program objective memorandum.⁴⁶

Because of changes in the implementation strategy, in September 2009, the DOD MDA approved a revised Milestone A for ECSS. The revised milestone provides for additional funding, and it grants the Air Force authority to continue with ECSS technology development and prepare for Milestone B for phase 1. In preparing for Milestone B, the Air Force was directed to

- present quarterly reports regarding the progress of the program, including internal and external challenges and risks, to the IRBs for weapons system, material, service, and financial management;
- complete an enterprise risk assessment methodology review of the program 120 days prior to Milestone B; and
- provide a cost analysis requirement document to the Air Force Analysis Agency to support the development of an independent cost estimate.

⁴⁵GAO-08-866.

⁴⁶The program objective memorandum details planned resource allocation 6 years in the future.

According to the PMO, each of these actions was completed by May 20, 2010.

Service Specific Integrated Personnel and Pay Systems⁴⁷

DOD Program Data for Service Specific Integrated Personnel and Pay Systems, as of December 31, 2009

Date of Initiation: February 1998

Program owner: Army—Army's Program Executive Office, Enterprise Information Systems
Navy—Chief of Naval Operations
Air Force—Air Force Program Executive Office and Service Acquisition Executive

Reported life-cycle cost estimate: Army—Has not yet been determined
Navy—\$1.3 billion
Air Force—\$1.7 billion

Reported amount expended: \$841.1 million

Legacy systems to be replaced: Army—65
Navy—7
Air Force—Has not yet been determined

Reported annual cost of maintaining legacy systems: Army—\$39 million
Navy—\$69 million
Air Force— Has not yet been determined

Number of system interfaces: Has not yet been determined

Date of last certification of funding: Not applicable for the military services as of December 2009

Number of system users: Has not yet been determined

Number of locations: Has not yet been determined

Sources: The Army, Navy, and Air Force program management offices. These data have not been validated.

⁴⁷Each military department refers to its respective personnel and pay system by a different name—the Integrated Personnel and Pay System—Army, the Navy Future Pay and Personnel Solution, and the Air Force Integrated Personnel and Pay System. For purposes of this report, we are collectively referring to these efforts as the Service Specific Integrated Personnel and Pay Systems—a name used by DOD.

Program Status

In a January 2009 memorandum, the Deputy Secretary of Defense changed the department's strategy for implementing an integrated personnel and pay system. The memorandum directed the BTA to develop the pay module and provide it to the military departments. Each military department would be responsible for implementing an integrated personnel and pay system for its respective service. In revising the department's strategy, a subsequent memorandum issued September 2009 by the Under Secretary of Defense (Acquisition, Technology and Logistics) noted that the capabilities needed by DOD to develop integrated personnel and pay systems are best met through the military departments because of several risks, including governance, technical complexities, and past failed attempts of developing DIMHRS as a one-fits-all solution. The memorandum further noted that military departments were to use, to the maximum extent practical, the DIMHRS requirements related to the pay module developed by BTA. Highlighted below is the status of each of the military department's efforts to implement an integrated personnel and pay system.

Integrated Personnel and Pay System-Army (IPPS-A)

Army PMO officials told us that in accordance with the September 2009 memorandum, the Army intends to use the BTA-developed pay module, develop the personnel module and implement an integrated system. Once IPPS-A is developed it will be implemented in several phases. The first deployment is planned for the Army National Guard, followed by the Army Reserves, and then the active Army. The PMO stated that the personnel and pay portion will be deployed to all Army components by August 2014. The Army anticipates that full deployment will occur late in fiscal year 2014. The PMO informed us that the Army is in the process of developing the life-cycle cost estimate.

Navy Future Pay and Personnel Solution

According to PMO officials, the Navy is in the process of evaluating the extent to which the BTA-developed pay module can be used to meet its needs for an integrated system. Navy anticipates that this evaluation will be completed by the second quarter of fiscal year 2011. PMO officials told us that if the pay module can be used, the system will be implemented in two phases. Phase 1 will consolidate the existing legacy personnel systems and establish a single personnel record. Phase 2 will be the implementation of the pay module. Navy would begin deployment in fiscal year 2014 for phase 1 and fiscal year 2015 for phase 2, with full deployment being achieved in fiscal year 2017. PMO officials told us that the Navy estimates that the life-cycle cost estimate for its integrated personnel and pay system will be about \$1.3 billion. The PMO further stated that if an alternative to using the BTA-developed pay module is selected, the implementation dates and estimated cost may change. In the September

2009 memorandum, it was noted that the Marine Corps will continue to use the Marine Corps Total Force System because it is already an integrated personnel and pay system.

Air Force Integrated Personnel and Pay System

At the time of our review, Air Force was evaluating the BTA-developed pay module to assess whether it could be used. According to the PMO, the system will be implemented in three phases, provided the existing BTA-developed pay module can be used. Phase 1 will consist of transferring data from the legacy systems to the new integrated personnel and pay system and will include implementation of leave/benefits for all. Phase 2 will provide an integrated personnel and pay solution for active Air Force officers, and phase 3 will deploy the system to the rest of the Air Force personnel including guard and reserve personnel. The quantity and content of the phases may change as the Air Force evolves the acquisition and deployment strategies. According to the PMO, it is anticipated that full deployment will be achieved in April 2018. The Air Force PMO currently estimates the life-cycle cost estimate to be about \$1.7 billion covering fiscal year 2010 through fiscal year 2027. The PMO told us that as the Air Force better defines its implementation strategy, the implementation dates and life-cycle cost estimate could change. The PMO also said that the Air Force is in the process of ascertaining how many legacy systems can be eliminated through its implementation of an integrated personnel and pay system.

Defense Agencies Initiative

DOD Program Data for DAI, as of December 31, 2009

Date of Initiation: January 2007

Program owner: The Business Transformation Agency was the first entity to implement DAI. Each defense agency will be responsible for the management and oversight of its respective implementation.

Reported life-cycle cost estimate:

	Has not yet been determined
• Development and Modernization	Has not yet been determined
• Operations and Maintenance	Has not yet been determined

Reported amount expended: \$40.2 million

Reported legacy systems to be replaced: 17

Reported annual cost of maintaining legacy systems: \$35 million

Number of system interfaces: 24

Date of last certification of funding: September 30, 2009 by the DBSMC

Number of system users: 15,000 (estimated)

Number of locations: 11 (estimated)

Source: DOD's DAI Program Management Office. These data have not been validated.

Program Status

DAI became operational at BTA in October 2008 and at the Defense Technical Information Center in October 2009. Table 3 lists the defense agencies that are scheduled to implement DAI in fiscal years 2011 through 2013.

Table 3: Defense Agencies' Scheduled Implementation of DAI

Defense agency	Fiscal year 2011	Fiscal year 2012	Fiscal year 2013
Uniform Services University of the Health Services	X		
Missile Defense Agency	X		
Defense Threat Reduction Agency		X	
Defense Information Systems Agency		X	
Defense Technology Security Administration		X	
Chemical Biological Defense Program		X	
TRICARE Management Agency— Headquarters		X	
Defense Media Agency		X	
Defense Information System Agency— General Fund			X
Defense Acquisition University			X
Defense POW/Missing Personnel Office			X
Defense Advanced Research Projects Agency			X
Defense Security Service			X
Office of Economic Adjustment			X
Center for Countermeasures			X
National Defense University			X

Source: Business Transformation Agency.

There has been some slippage in the implementation schedule. However, at the time of our review, a revised full deployment date for all of the agencies scheduled to use DAI had not been established. According to the department's fiscal year 2011 IT budget request, additional defense agencies have expressed an interest in using DAI. However, the Financial Management IRB and the DBSMC must grant approval to any entity that wants to use DAI. DOD's budget request notes that the total cost of the program is affected by the number of agencies participating. The budget request further notes that a more accurate implementation-plus-sustainment cost can be determined once all of the signed memorandums of intent from agencies wanting to use DAI have been received.

DOD Did Not Follow Key Best Practices for Estimating ERP Schedules and Cost, Resulting in Unreliable Estimates

Our analysis of the schedules and cost estimates for four ERP programs—DEAMS, ECSS, GFEBS, and GCSS-Army—found that none of the programs are fully following best practices for developing reliable schedules and cost estimates. More specifically, none of the programs had developed a fully integrated master schedule (IMS) that reflects all activities, including both government and contractor activities. In addition, none of the programs established a valid critical path or conducted a schedule risk analysis.⁴⁸ We have previously reported that the schedules for GCSS-MC and Navy ERP were developed using some of these best practices, but several key practices were not fully employed that are fundamental to having a schedule that provides a sufficiently reliable basis for estimating costs, measuring progress, and forecasting slippages.⁴⁹ We recommended that each program follow best practices to update its respective schedule. DOD generally agreed with the recommendations. Additional details on the status of the recommendations are discussed in appendix III. The success of any program depends on having a reliable schedule of the program's work activities that will occur, how long they will take, and how the activities are related to one another. As such, the schedule not only provides a road map for systematic execution of a program, but also provides the means by which to gauge progress, identify and address potential problems, and promote accountability.

Our analysis of the four programs' cost estimates found that ECSS, GFEBS, and GCSS-Army did not include a sensitivity analysis, while cost estimates for GFEBS did not include a risk and uncertainty analysis. GAO, OMB, and DOD guidance⁵⁰ stipulate that risk and uncertainty analysis should be performed to determine the level of risk associated with the dollar estimate. Furthermore, a sensitivity analysis would assist decision makers in determining how changes to assumptions or key cost drivers (such as labor or equipment) could affect the cost estimate. We have previously reported that the cost estimates for Navy ERP and GCSS-MC are comprehensive and well-documented, but only partially accurate and

⁴⁸A critical path is the longest duration path through a sequenced list of activities within a schedule. A schedule risk analysis uses statistical techniques to predict a level of confidence in meeting a completion date.

⁴⁹[GAO-08-822](#) and [GAO-08-896](#).

⁵⁰[GAO-09-3SP](#); OMB Revised Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (Oct. 29, 1992); and DOD Instruction 7041.3, *Economic Analysis of Decisionmaking* (Nov. 7, 1995).

credible.⁵¹ We recommended that each program update its respective cost estimate following best practices. The department generally agreed with the recommendations. Additional details on the status of the recommendations are discussed in appendix III. For DOD management to make good decisions, the program estimate must reflect the degree of uncertainty so that a level of confidence can be given about the estimate. A reliable cost estimate provides the basis for informed investment decision making, realistic budget formulation and program resourcing, meaningful progress measurement, proactive course correction, and accountability for results.

Program Schedules Not Developed in Accordance with Key Scheduling Practices

Our cost guide best practices and related federal guidance call for a program schedule to be programwide, meaning that it should include an integrated breakdown of the work to be performed by both the government and its contractors over the expected life of the program.⁵² Our guidance identifies nine scheduling best practices that are integral to a reliable and effective master schedule: (1) capturing all activities, (2) sequencing all activities, (3) assigning resources to all activities, (4) establishing the duration of all activities, (5) integrating schedule activities horizontally and vertically, (6) establishing the critical path for all activities, (7) identifying float between activities, (8) conducting a schedule risk analysis, and (9) updating the schedule using logic and durations to determine the dates.

The scheduling best practices are interrelated so that deficiencies in one best practice will cause deficiencies in other best practices. For example, if the schedule does not capture all activities, then there will be uncertainty about whether activities are sequenced in the correct order and whether the schedule properly reflects the resources needed to accomplish the work. The schedule should use logic and durations in order to reflect realistic start and completion dates for program activities. Maintaining the integrity of the schedule logic is not only necessary to reflect true status, but is also required before conducting follow-on schedule risk analyses. If the schedule is not properly updated, positive and negative float will not change properly. Positive float indicates the

⁵¹GAO-08-822 and GAO-08-896.

⁵²See, for example, GAO-09-3SP; and OMB *Capital Programming Guide V 2.0, Supplement to Office of Management and Budget Circular A-11, Part 7: Planning, Budgeting, and Acquisition of Capital Assets* (Washington, D.C.: June 2006).

amount of time the schedule can fluctuate before affecting the end date. Negative float indicates critical path effort that may require management action such as overtime, second or third shifts, or resequencing of work. Moreover, if activities are not properly sequenced with logical links, it is not certain whether the critical path—which represents the chain of dependent activities with the longest total duration—is valid. Table 4 summarizes the results of our review of the four programs.

Table 4: Extent to Which Program Schedules Met Best Practices

Best practice	Extent best practice met			
	DEAMS	ECSS ^a	GFEBs	GCSS-Army
1. Capturing all activities	Partially	Substantially	Substantially	Partially
2. Sequencing all activities	Minimally	Partially	Partially	Partially
3. Assigning resources to all activities	Fully met	Minimally	Not Met	Substantially
4. Establishing the duration of all activities	Substantially	Substantially	Fully Met	Fully Met
5. Integrating schedule activities horizontally and vertically	Minimally	Partially	Minimally	Partially
6. Establishing the critical path for all activities	Minimally	Partially	Partially	Partially
7. Identifying reasonable float between activities	Minimally	Partially	Minimally	Substantially
8. Conducting a schedule risk analysis	Minimally	Not met	Not met	Minimally
9. Updating schedule using logic and durations to determine dates	Minimally	Partially	Partially	Substantially

Sources: GAO analysis based on data provided by the PMOs.

Note: “Not met” means the program provided no evidence that satisfies any of the criterion. “Minimally” means the program provided evidence that satisfies a small portion of the criterion. “Partially” means the program provided evidence that satisfies about half of the criterion. “Substantially” means the program provided evidence that satisfies a large portion of the criterion. “Fully met” means the program provided evidence that completely satisfies the criterion.

^aIn reviewing ECSS we analyzed two project schedules: (1) solutions development and (2) reports, interfaces, conversions, and extensions (RICE). We analyzed two schedules because the ECSS IMS is made up of 46 individual project schedules. The ratings were exactly the same for the nine practices.

Highlighted below are examples of the specific weaknesses we found in each of the nine best practices.⁵³ Appendix IV contains a detailed discussion of the extent to which the four ERPs we analyzed met the nine best practice criteria.

- *Capturing all activities.* A schedule should reflect all activities as defined in the program’s work breakdown structure to include activities to be performed by the government and the contractor. Our analysis found that

⁵³ [GAO-09-3SP](#).

the ERP program schedules differed in the extent to which they capture all activities, as well as in the integration of government and contractor activities. The DEAMS PMO does not have a single schedule that integrates government and contractor activities. While the PMO maintains internal schedules that reflect government-only activities, these activities are not linked to contractor activities. In addition, many contractor activities within the DEAMS schedule are not mapped to the work breakdown structure, hampering management's ability to ensure all effort is included in the schedule. While the GCSS-Army schedule identifies contractor activities, it contains only key government milestones for the program. Other government activities, such as testing events and milestones beyond December 2010, are not captured in the schedule. The ECSS program schedule contains detailed activities associated with government effort and contractor effort. However, the government activities are not fully linked to contractor activities, so that updates to government activities do not have a direct impact on scheduled contractor activities. While the GFEBS's schedule captures government and contractor activities, dependencies between key milestones in deployment, software release, and maintenance are not linked, thereby precluding a comprehensive view of the entire program. Without fully integrating government activities with contractor activities, the schedule will not be able to reliably estimate the date the program is to be finished if a significant amount of key activities are not adequately captured.

- *Sequencing all activities.* The schedule should be planned so that it can meet program critical dates. To meet this objective, activities need to be logically sequenced in the order that they are to be carried out and no artificial date constraints should be included in the schedule. In particular, activities that must finish prior to the start of follow-on activities (i.e., predecessor activities), as well as activities that cannot begin until other activities are completed (i.e., successor activities), should be identified. None of the contractor schedules we assessed fully met the criteria for sequencing all activities. For example, the DEAMS schedule has over 60 percent of the remaining activities missing logic links to predecessor or successor activities. Missing predecessors or successors reduce the credibility of the calculated dates. The DEAMS schedule also has date constraints⁵⁴ that keep the schedule from responding correctly to changes. The ECSS schedule has 78 instances of unusual logic that cause activities

⁵⁴A constraint predefines the start, finish, or both dates of an activity. The schedule should use logic and durations in order to reflect realistic start and completion dates for activities.

to finish at the same time that their predecessor activities start.⁵⁵ The GCSS-Army schedule has constraints on 1,503 of the remaining activities that keep the schedule from responding to changes. Moreover, the GFEBs schedule has date constraints and linked summary activities that interfere with the critical path.⁵⁶ Missing or incorrect logic reduces the credibility of the calculated dates in the schedule because the schedule will not reflect the effects of slipping activities on the critical path, scheduled resources, or scheduled start dates of future activities.

- *Assigning resources to all activities.* The schedule should realistically reflect what resources (i.e., labor, material, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist. Because of the fixed price contractual arrangements with ERP contractors, resources are not reflected in the periodic updates of the schedules submitted to the PMOs. While the GCSS-Army IMS does not include resources, scheduled activities can be traced to control account plans which have resources laid out by month by labor category. On the other hand, the DEAMS PMO provided evidence that resources were assigned to activities in the schedule. In the case of ECSS, PMO officials stated the contractor assigned resources to scheduled activities, but we were not able to verify whether resources were assigned. The GFEBs contractor's schedules had resources assigned to activities in earlier releases of the system, but according to the PMO, resources are no longer assigned to activities. Without resource information, DOD management has insufficient insight into current or projected over-allocation of contractor resources, thus increasing the risk of slippage in the estimated completion date.
- *Establishing the duration of all activities.* The schedule should reflect how long each activity will take to execute and activity durations should be as short as possible with specific start and end dates. The four programs properly reflected how long each activity should take to execute. In addition, activities were generally shorter than 44 working days—or 2 working months—which represents best practices for activity durations.

⁵⁵These unusual links are known as start-to-finish links, and they are rarely, if ever, used in scheduling. Schedules should contain a predominance of finish-to-start logical relationships so that one can know which activities must finish before others begin.

⁵⁶Summary activities summarize the effort of multiple lower-level tasks.

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- *Integrating schedule activities horizontally and vertically.* The schedule should be integrated horizontally and vertically. Horizontal integration means that the schedule links the products and outcomes associated with already-sequenced activities. Horizontal integration also demonstrates that the overall schedule is rational, planned in a logical sequence or to reflect interdependencies between work and planning packages and provides a way to evaluate current status. When schedules are vertically integrated, lower-level schedules are clearly traced to upper-tiered milestones, allowing for total schedule integration and enabling different teams to work to the same schedule expectations. The program schedules we assessed partially met the criteria for horizontal and vertical integration. In general, as discussed earlier, issues with missing or convoluted logic and artificially constrained dates prevent the program schedules from being horizontally integrated. Schedules that are not horizontally integrated may not depict relationships between different program elements and product handoffs. While ECSS and GCSS-Army program schedules are vertically integrated, the inability to clearly trace lower-level schedules to upper-tiered milestones prevent the DEAMS and GFEBS program schedules from being fully vertically integrated.
 - *Establishing the critical path.* The establishment of a critical path—the longest duration path through the sequenced list of activities—is necessary for examining the effects of any activity slipping along this path. The calculation of a critical path is directly related to the logical sequencing of events. Missing or convoluted logic and artificially constrained dates prevent the calculation of a valid critical path, and can mark activities as critical that are not truly critical. The program schedules either partially or minimally met the criteria for establishing a critical path. While the ECSS PMO has insight into detailed contractor activities, officials acknowledged that it is difficult to establish a critical path using the program’s current schedule. Instead, the program tracks high-level milestones in a separate schedule and officials stated that they are in the process of revamping the program’s work breakdown structure in order to establish a clearer relationship between work products and hence a more accurate critical path. While the GFEBS PMO stated that it receives weekly updates from the contractor and manages to a critical path, our analysis of GFEBS concluded that the critical path was not reliable because of artificial date constraints and unrealistic float.⁵⁷ Conversely, GCSS-Army and DEAMS officials stated that regardless of insight into detailed contractor activities, a critical path is not possible because it

⁵⁷Float is the amount of time by which a predecessor activity can slip before the delay affects successor activities.

would be too complex. However, as program complexity increases, so must the schedule's sophistication. Further, our analysis of the DEAMS schedule found that it would be impossible to develop a critical path because 60 percent of the remaining activities are missing logic links. Likewise, our analysis found that a critical path within the GCSS-Army schedule is not possible because of artificial date constraints placed on key activities. While the level of complexity in an ERP is daunting, a critical path through at least a higher-level version of the detailed schedule would assist management in identifying which slipped tasks will have detrimental effects on the completion date. By managing to pre-defined, constrained dates instead of a critical path, management does not have a clear picture of the tasks that must be performed to achieve the target completion date.

- *Identifying reasonable float between activities.* The schedule should identify float—the time that a predecessor activity can slip before the delay affects successor activities—so that schedule flexibility can be determined. As a general rule, activities along the critical path typically have the least amount of float. The DEAMS, ECSS, and GFEBS schedules did not meet the criteria for identifying reasonable float. The missing or convoluted logic and artificially constrained dates identified above prevent the proper calculation of float, which in turn affects the identification of a valid critical path. Without proper insight into float, management cannot determine the flexibility of tasks and therefore cannot properly reallocate resources from tasks that can safely slip to tasks that cannot slip without adversely affecting the estimated program completion date.
- *Conducting a schedule risk analysis.* A schedule risk analysis uses statistical techniques to predict a level of confidence in meeting a completion date. The purpose of the analysis is to develop a probability distribution of possible completion dates that reflect the project and its quantified risks. This analysis can help management to understand the most important risks and to focus on mitigating these risks. We found that none of the PMOs have explicitly linked program risks to their schedule in the form of a schedule risk analysis. The ECSS PMO stated that it actively monitors schedule risk, but it has not performed a schedule risk analysis. The GFEBS PMO stated that while schedule risks have been discussed in team meetings, it has not performed a formal schedule risk analysis. However, the GFEBS PMO stated that it is open to improving in the area of schedule risk analysis. The DEAMS PMO stated that while it has tied risks to activities the program considers to be on the critical path, a formal schedule risk analysis was not performed because the schedule provided by the contractor lacks a sufficient level of detail to do such an analysis. The GCSS-Army contractor recently conducted a high-level schedule risk

analysis on two major milestones. In addition, GCSS-Army PMO officials acknowledged the importance of a detailed schedule risk analysis and stated that the PMO intends to include this requirement in the contract within the next few months. A schedule risk analysis is important because it allows high-priority risks to be identified and mitigated, and the level of confidence in meeting projected completion dates can be predicted. Without a schedule risk analysis, the PMO cannot reliably determine the level of confidence in meeting the completion date. However, if the schedule risk analysis is to be credible, the program must have a quality schedule that reflects reliable logic and clearly identifies the critical path—conditions that none of the ERP schedules met.

- *Updating the schedule using logic and durations to determine dates.* The schedule should use logic and durations in order to reflect realistic start and completion dates. The schedule should be continually monitored to determine when forecasted completion dates differ from the planned dates, which can be used to determine whether schedule variances will affect future work. There are differences in the four programs' ability to update the schedule using logic and durations to determine schedule dates. For example, the GCSS-Army schedule substantially met the criteria for updating the schedule, but the GFEBS schedule has over 100 instances of activities that should have occurred, yet have no actual start dates or finish dates. In addition, the ECSS schedules had a status date of January 1, 2010—a federal holiday—while schedules provided to the DEAMS program office by the contractor did not have a status date. A status date denotes the date of the latest update to the schedule and therefore defines the point in time at which completed work and remaining work are calculated. Without a valid status date, management is not able to determine what work is completed and what work is remaining. An invalid or missing status date is also an indication that management is not using the schedule to effectively oversee and monitor the effort. Furthermore, maintaining the integrity of the schedule logic is not only necessary to reflect true status, but is also required before conducting a schedule risk analysis.

Each of the PMOs acknowledged the importance of many of the scheduling best practices, but stated that its ability to meet the prescribed best practices is limited because of the complexity of the ERP development process and the use of the firm-fixed price contract. Under the terms of these firm-fixed price contracts, the contractors are not required to provide detailed and timely scheduling data, which are essential for preparing order and an accurate and reliable schedule for the implementation of the system. While some of the necessary information is not being provided by the contractor, this does not relieve the PMOs of the

responsibility for developing an IMS that fully meets prescribed best practices. Without the development of an IMS that meets scheduling best practices, the PMOs and the department are not positioned to adequately monitor and oversee the progress of the billions of dollars being invested in the modernization of DOD's business systems. Lacking a credible IMS, management is unable to predict, with any degree of confidence, whether the estimated completion date is realistic. An integrated schedule is key in managing program performance and is necessary for determining what work remains and the expected cost to complete it. A schedule delay can also lead to an increase in the cost of the project because, for example, labor, supervision, facilities, and escalation cost more if the program takes longer. A schedule and cost risk assessment recognizes the interrelationship between schedule and cost and captures the risk that schedule durations and cost estimates may vary. But without a fully integrated master schedule, the full extent of schedule uncertainty is not known, and therefore cannot be incorporated into the cost uncertainty analysis as schedule risk.

Subsequent to the completion of our field work, ECSS and GFEBS PMOs provided updated schedules for assessment, but we were unable to perform a detailed evaluation of the updated schedules. Program officials for ECSS and GFEBS indicated that the updated schedules addressed some areas in which their previous schedules were deficient according to GAO's assessment of the nine scheduling best practices. In response to limitations that we identified and shared with the GFEBS PMO, the program office enacted several formal changes to its existing schedule. The ECSS PMO provided us with an updated IMS that contains details on future activities beyond the scheduled activities we originally assessed. Although we did not assess the new schedule, according to the ECSS PMO, the updated schedule is an improvement over past versions of the ECSS schedule and addresses many of the deficiencies GAO identified in the earlier version.

Although Cost Estimates Meet Most Best Practices, the Lack of Sensitivity and Uncertainty Analyses Results in Estimates That May Not Be Credible

We have identified⁵⁸ four characteristics of a reliable cost estimate (1) well-documented, (2) comprehensive, (3) accurate, and (4) credible. The four characteristics encompass 12 best practices for effective program cost estimates that are identified in appendix V. The results of our review of the DEAMS, ECSS, GFEBS, and GCSS-Army cost estimates are summarized in table 5.

Table 5: Extent Cost Estimates Met Best Practices

Best practice	DEAMS	ECSS	GFEBS	GCSS-Army
Well-documented	Substantially	Substantially	Fully met	Substantially
Comprehensive	Fully met	Fully met	Fully met	Substantially
Accurate	Fully met	Substantially	Substantially	Partially
Credible	Fully met	Partially	Minimally	Partially

Sources: GAO analysis based on information provided by the PMOs.

Note: “Not met” means the program provided no evidence that satisfies any of the criterion. “Minimally” means the program provided evidence that satisfies a small portion of the criterion. “Partially” means the program provided evidence that satisfies about half of the criterion. “Substantially” means the program provided evidence that satisfies a large portion of the criterion. “Fully met” means the program provided evidence that completely satisfies the criterion.

Highlighted below are examples of the specific strengths and weaknesses we found in each of the four best practices. Appendix V contains a detailed discussion of the extent to which the four ERPs we analyzed met the four best practices criteria.

- *Well-documented.* The cost estimates should be supported by detailed documentation that describes the purpose of the estimate, the program background and system description, the scope of the estimate, the ground rules and assumptions, all data sources, estimating methodology and rationale, and the results of the risk analysis. Moreover, this information should be captured in such a way that the data used to derive the estimate can be traced back to, and verified against, their sources. The cost estimates for DEAMS, ECSS, GFEBS, and GCSS-Army are well-documented. The cost estimates have clearly defined purposes and are supported by documented descriptions of key program or system characteristics (e.g., relationships with other systems, performance parameters). Additionally, they capture in writing such things as the

⁵⁸ [GAO-09-3SP](#).

source data used and their significance, the calculations performed and their results, and the rationale for choosing a particular estimating method or reference. This information is captured in such a way that the data used to derive the estimate can be traced back to, and verified against, the sources. The final cost estimates are reviewed and accepted by management on the basis of confidence in the estimating process and the estimate produced by the process.

- *Comprehensive.* The cost estimates should include costs of the program over its full life cycle, provide a level of detail appropriate to ensure that cost elements are neither omitted nor double-counted, and document all cost-influencing ground rules and assumptions. We found that cost estimates for DEAMS, ECSS, GFEBS, and GCSS-Army are comprehensive. The cost estimates include both government and contractor costs over the program's life cycle, from the inception of the program through design, development, deployment, and operation and maintenance to retirement. They also provide an appropriate level of detail to ensure that cost elements are neither omitted nor duplicated and include documentation of all cost-influencing ground rules and assumptions.
- *Accurate.* The cost estimates should be based on an assessment of most likely costs (adjusted for inflation), documented assumptions, and historical cost estimates and actual experiences on other comparable programs. Estimates should be cross-checked against an independent cost estimate for accuracy, double counting, and omissions. In addition, the estimates should be updated to reflect any changes. Our analysis also found the cost estimates for DEAMS, ECSS, and GFEBS to be accurate. The cost estimates provide for results that are unbiased and are not overly conservative or optimistic. In addition, the cost estimates are updated regularly to reflect material changes in the program, and steps are taken to minimize mathematical mistakes and their significance. Among other things, the cost estimates are grounded in historical record of cost estimating and actual experiences on comparable programs. Our analysis found the cost estimate for GCSS-Army to be partially accurate because we could not verify how actual incurred costs were used to update the cost estimate.
- *Credible.* The cost estimates should discuss any limitations of the analysis because of uncertainty, or biases surrounding data or assumptions. Risk and uncertainty analysis should be performed to determine the level of risk associated with the estimate. Further, the estimate's results should be

cross-checked against an independent cost estimate.⁵⁹ While we found that the ERP programs were generally following the cost estimating best practices, our analysis also found that the cost estimates for ECSS, GFEBS, and GCSS-Army are not fully credible. As stipulated in OMB and DOD guidance, ECSS and GCSS-Army did not include a sensitivity analysis, and GFEBS did not include a sensitivity analysis or a cost risk and uncertainty analysis. In the case of GFEBS, our July 2007 report⁶⁰ noted that a sensitivity analysis had not been developed in calculating the life-cycle cost estimate. Cost estimates should discuss any limitations of the analysis because of uncertainty or biases surrounding data and assumptions. Major assumptions should be varied, and other outcomes recomputed to determine how sensitive they are to changes in the assumptions. Having a range of costs around a point estimate is more useful to decision makers because it conveys the level of confidence in achieving the most likely cost and also informs them of cost, schedule, and technical risks. In addition, as discussed earlier, because each of the four programs we assessed did not meet best practices for schedule estimating, none of the cost estimates could be considered credible because they did not assess the cost effects of schedule slippage. While individual phases of a multi-phased project may be completed on time, the project as a whole can be delayed, and phases that are not part of an IMS may not be completed efficiently which could result in future cost overruns.

A reliable cost estimate is a key variable in calculating return on investment, and it provides the basis for informed investment decision making, realistic budget formulation and program resourcing, meaningful progress measurement, proactive course correction, and accountability for results. According to OMB⁶¹ programs must maintain current and well-documented cost estimates, and these estimates must encompass the full life cycle of the program. OMB states that generating reliable cost estimates is a critical function necessary to support OMB's capital programming process. Without reliable estimates, programs are at

⁵⁹An independent cost estimate is another estimate based on the same technical information that is used to validate and cross-check the baseline estimate, but is prepared by a person or organization that has no stake in the approval of the project.

⁶⁰[GAO-07-860](#).

⁶¹OMB Circular No. A-11, *Preparation, Submission, and Execution of the Budget* (June 2006); OMB Circular No. A-130, Revised, *Management of Federal Information Resources* (Nov. 28, 2000); and Office of Management and Budget, *Capital Programming Guide: Supplement to Circular A-11, Part 7, Preparation, Submission, and Execution of the Budget* (June 2000).

increased risk of experiencing cost increases, missed deadlines, and performance shortfalls.

ERP Success in Transforming Business Operations Has Not Been Defined or Measured

DOD has not yet defined success for ERP implementation in the context of business operations and in a way that is measurable. Accepted practices in system development include testing the system in terms of the organization's mission and operations—whether the system performs as envisioned at expected levels of cost and risk when implemented within the organization's business operations. The Clinger-Cohen Act of 1996 recognizes the importance of performance measurement in requiring agencies to (1) establish goals for improving the efficiency and effectiveness of agency operations and (2) ensure that performance measurements determine how well the information technology supports programs of the executive agency.⁶²

DOD also has recognized the importance of performance measures, which the department directs should be (1) written in terms of desired outcomes, (2) quantifiable, (3) able to measure the degree to which the desired outcome is achieved, (4) independent of the particular automated system tested and not focused on system-performance criteria, and (5) designed to include benefits to the DOD component and the enterprise. In regard to the ERPs, measures determining whether the system is being used as expected and is providing the desired benefits from a business perspective will vary depending on the specific type of business functions the system is performing. For example, in a logistical system, the new system and its processes may be expected to help accomplish such items as (1) reducing inventory levels; (2) increasing the inventory turnover rate which shows that the items actually needed are the items being procured; and (3) increasing the accuracy of the projected completion dates for repair projects which allows for better equipment utilization. On the other hand, a financial system may measure benefits in such areas as (1) reducing prompt payment penalties; (2) improving the financial statement preparation process by having the system automatically generate the statements which reduces the potential for manual error; and (3) improving management oversight of an entity's operations and providing the detailed data necessary to evaluate abnormalities that may be detected. Developing and using specific performance measures to

⁶²Pub. L. No. 104-106, div. E, title LI, § 5123, 110 Stat. 679, 683-84 (Feb. 10, 1996), *codified, as amended*, at 40 U.S.C. § 11313.

evaluate a system effort should help management understand whether the expected benefits are being realized.

While the definition of success and performance measures for DOD's ERPs will differ between organizational levels, components, and subcomponents, our previous work has shown that performance measures should be aligned toward a shared direction. In this regard, all members of the organization need to understand the ultimate result to be achieved and all parties should work toward the same goal and desired results. This alignment should extend throughout the organization and cover the activities that an entity is expected to perform to support the intent of the program.⁶³ DOD has not taken actions to align the definitions and related performance measures used by its components to measure progress and determine success.

The DCMOs told us that they had not yet developed a DOD-wide definition of success or related performance measures for ERPs. While acknowledging the importance of these practices, the officials told us that they are still in the early stages of implementing processes for managing and overseeing their business systems modernization efforts, in accordance with the fiscal year 2010 Defense Authorization Act. Successful implementation of the ERPs is critical to transforming business operations. Without defining ERP success in terms of support for mission and business operations and establishing the related performance measures, the military services and the department cannot ensure that the performance of deployed ERPs has been realistically and accurately measured.

Our April 2010 report,⁶⁴ which focused on the second deployment of LMP at the Corpus Christi and Letterkenny Army Depots, illustrates the importance of establishing performance measures. Based on our observations at the Corpus Christi and Letterkenny Army Depots, we found that the Army's measures for assessing LMP implementation at the two deployment sites did not accurately reflect whether the locations were able to perform their day-to-day operations using LMP as envisioned. Rather, the measures used by the Army assessed the success at the two locations from a system-software perspective. While this is important,

⁶³GAO, *Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures*, [GAO-03-143](#) (Washington, D.C.: Nov. 22, 2002).

⁶⁴[GAO-10-461](#).

performance measures from a business perspective were not considered to determine whether the depots were able to use LMP to perform their mission to repair items. Without performance measures to evaluate how well these systems are accomplishing their desired goals, DOD decision makers including program managers do not have all the information they need to evaluate their investments to determine whether the individual programs are helping DOD achieve business transformation and thereby improve upon its primary mission of supporting the warfighter.

Conclusions

Modernizing the department's business systems is a critical part of transforming DOD's business operations, addressing some of its high-risk areas, and providing more accurate and reliable financial information to the Congress on the results of DOD's operations. However, DOD continues to experience difficulties that hinder its ability to implement these efforts on time and within budget. The department has not followed best practices and developed a reliable IMS for several of these modernization efforts. As a result, it lacks the assurance that these ERPs will be completed by the projected date. Furthermore, while DOD generally followed best practices in developing the programs' cost estimates for these efforts, with the exception of DEAMS, none of the programs has prepared a sensitivity analysis. The lack of a sensitivity analysis increases the chances that decisions will be made without a clear understanding of the possible impact on the estimates of costs and benefits of each program. In addition, because each of the four programs we assessed did not meet best practices for schedule estimating, none of the cost estimates could be considered credible because they did not assess the cost effects of schedule slippage. It is critical to correct the underlying issues to help ensure that the billions of dollars spent annually are being used in the most efficient and effective manner. While modernizing its business systems is not a risk-free endeavor, additional funds spent because of schedule slippages are funds that could have been available for other departmental priorities. Furthermore, the longer it takes to implement these critical business systems, the longer the department will continue to use its existing duplicative, stovepiped systems environment and further erode the estimated savings that were to accrue to DOD as a result of modernizing its business systems.

Additionally, the department has not defined the measures to ascertain if the systems are providing the desired functionality to achieve DOD's business transformation goals. DOD has stated that the successful implementation of the ERPs is critical to transforming its business operations and addressing some of its high-risk areas. However, we found

that the department has not yet developed performance measures to ascertain whether the systems, once implemented, are providing the intended functionality. If the systems cannot be used for their intended purpose, transformation will be difficult if not impossible to achieve and the billions of dollars being invested in these systems may not generate the benefits and efficiencies as intended. Further, we reaffirm our prior recommendations related to the actions needed to improve the department's management and oversight of the ERPs.

Recommendations for Executive Action

To strengthen DOD's management oversight and accountability over business system investments and help provide for the successful implementation of the ERPs, we recommend that the Secretary of Defense take the following eight actions:

- Direct the Secretary of the Army to ensure that the Chief Management Officer of the Army directs the PMO for the GFEBS to develop an IMS that fully incorporates best practices. The schedule should
 - sequence all activities,
 - assign resources to all activities,
 - integrate schedule activities horizontally and vertically,
 - establish the critical path for all activities,
 - identify float between activities,
 - conduct a schedule risk analysis, and
 - update schedule using logic and durations to determine dates.

- Direct the Secretary of the Army to ensure that the Chief Management Officer of the Army direct the PMO for GCSS-Army to develop an IMS that fully incorporates best practices. The schedule should
 - capture all activities,
 - sequence all activities,
 - integrate schedule activities horizontally and vertically,
 - establish the critical path for all activities, and
 - conduct a schedule risk analysis.

- Direct the Secretary of the Air Force to ensure that the Chief Management Officer of the Air Force directs the PMO for DEAMS to develop an IMS that fully incorporates best practices. The schedule should
 - capture all activities,
 - sequence all activities,
 - integrate schedule activities horizontally and vertically,

-
- establish the critical path for all activities,
 - identify float between activities,
 - conduct a schedule risk analysis, and
 - update schedule using logic and durations to determine dates.
- Direct the Secretary of the Air Force to ensure that the Chief Management Officer of the Air Force directs the PMO for ECSS to develop an IMS that fully incorporates best practices. The schedule should
 - sequence all activities,
 - assign resources to all activities,
 - integrate schedule activities horizontally and vertically,
 - establish the critical path for all activities,
 - identify float between activities,
 - conduct a schedule risk analysis, and
 - update schedule using logic and durations to determine dates.
 - Direct the Secretary of the Army to ensure that the Chief Management Officer of the Army directs the PMO for GFEBS to update the cost estimates by preparing sensitivity and risk and uncertainty analyses using best practices.
 - Direct the Secretary of the Army to ensure that the Chief Management Officer of the Army directs the PMO for GCSS-Army to update the cost estimates by using actual cost and preparing a sensitivity analysis using best practices.
 - Direct the Secretary of the Air Force to ensure that the Chief Management Officer of the Air Force directs the PMO for ECSS to update the cost estimates by preparing a sensitivity analysis using best practices.
 - Direct the department's Chief Management Officer and the chief management officers of the military departments to establish performance measures based on quantitative data that will enable the department to assess whether each respective military service's ERP efforts are providing the intended business capabilities to the system users.

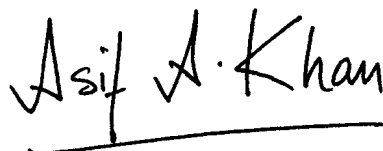
Agency Comments and Our Evaluation

DOD provided written comments on a draft of this report. In its comments, DOD concurred with the eight recommendations and cited actions planned to address them. For example, the department recognized the importance of an integrated master schedule as a key program management tool fundamental to having a reliable program schedule. The department stated that the appropriate military department Chief

Management Officer will direct program managers to implement the recommendations and further noted that the Chief Management Officer will oversee the implementation of the recommendations. Further, DOD stated that guidance will be issued requiring DOD business systems investments to include performance measures that can be used to assess the expected benefits of the investments. Additionally, the department noted that the performance measures will be incorporated into DOD's Business Enterprise Architecture.

We are sending copies of this report to the Secretary of Defense; the Secretary of the Army; the Secretary of the Navy; the Secretary of the Air Force; the Deputy Secretary of Defense; the Under Secretary of Defense (Comptroller); the Chief Management Officer of the Army, the Navy, and the Air Force; the program management office for each business system that was included in the audit; and other interested congressional committees and members. This report also is available at no charge on the GAO Web site at <http://www.gao.gov>.

Please contact Asif A. Khan at (202) 512-9095 or khana@gao.gov or Nabajyoti Barkakati at (202) 512-4499 or barkakatin@gao.gov if you or your staff have questions on matters discussed in this report. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix VI.



Asif A. Khan
Director
Financial Management and Assurance



Nabajyoti Barkakati
Chief Technologist
Applied Research and Methods
Center for Science, Technology, and Engineering

List of Requesters

The Honorable Evan Bayh
Chairman
The Honorable Richard Burr
Ranking Member
Subcommittee on Readiness and Management Support
Committee on Armed Services
United States Senate

The Honorable Thomas R. Carper
Chairman
The Honorable John McCain
Ranking Member
Subcommittee on Federal Financial Management, Government
Information, Federal Services, and International Security
Committee on Homeland Security and Governmental Affairs
United States Senate

The Honorable George Voinovich
Ranking Member
Subcommittee on Oversight of Government Management, the Federal
Workforce, and the District of Columbia
Committee on Homeland Security and Governmental Affairs
United States Senate

The Honorable Tom Coburn
Ranking Member
Permanent Subcommittee on Investigations
Committee on Homeland Security and Governmental Affairs
United States Senate

Appendix I: Objective, Scope, and Methodology

Our objectives were to (1) provide the status as of December 31, 2009 of the nine enterprise resource planning (ERP) systems that the Department of Defense (DOD) identified as essential to transforming its business operations; (2) assess the scheduling and cost estimating practices of selected ERPs to determine the extent to which the program management offices (PMO) were applying best practices; and (3) ascertain whether DOD and the military departments have defined the performance measures to determine whether the systems will meet their intended business capabilities.

To address the first objective, we obtained and reviewed information provided by the PMO responsible for the nine ERP efforts.¹ More specifically, we obtained data related to the following for each program: (1) when the program was initiated, (2) the program's accountable official, (3) the purpose of the program, (4) the cost of the program, (5) the implementation schedule, (6) the number of legacy systems intended to be replaced, (7) the cost of the legacy systems, (8) the date the program was last certified, and (9) the conditions placed on the program by the various review boards. For the purposes of this report, we did not include information on the Defense Logistics Agency Business System Modernization/Enterprise Business System. According to DOD the Business System Modernization effort was fully implemented in July 2007 and transformed how the agency conducts its operations in five core business processes: order fulfillment, demand and supply planning, procurement, technical/quality assurance, and financial management. Subsequently, in September 2007, the name of the program was changed to the Enterprise Business System, which is a continuation of the ERP's capabilities to support internal agency operations.

We also reviewed various DOD documents such as the Enterprise Transition Plans issued in September 2008 and December 2009, the Defense Business Systems Management Committee meeting minutes and briefings, the Selected Capital Investment Reports, which are prepared in support of the funding requests for the ERPs, the Congressional Report on Defense Business Operations for fiscal years 2009 and 2010 and the Major Automated Information System Reports for fiscal years 2008 and 2009—to corroborate the information obtained from the PMOs. In instances where

¹This engagement focused on nine ERP efforts that DOD considers critical to transforming its business operations and resolving some of the department's high-risk areas such as business transformation, business system modernization, financial management, and supply chain management.

we identified discrepancies, we followed up with the PMOs to obtain an explanation. Most of the financial information in this report was obtained through interviews with or responses to GAO questions from knowledgeable PMO officials for the nine ERP systems. As part of the first objective, we also reviewed past GAO reports² that were specific to the department's efforts to implement the nine ERPs to identify prior recommendations and assess DOD's progress in addressing the 19 recommendations discussed in these reports.

To assess the scheduling and cost estimating practices of selected ERPs, we selected the General Fund Enterprise Business System (GFEBS), the Global Combat Support System-Army (GCSS-Army), the Defense Enterprise Accounting and Management Systems (DEAMS), and the Expeditionary Combat Support System (ECSS). The other programs were excluded because (1) the Logistics Modernization Program is expected to be fully deployed soon, (2) it is too soon to assess the department's integrated personnel and pay efforts because of the recent change in the Defense Integrated Military Human Resources System implementation strategy and the Defense Agencies Initiative has yet to develop its implementation schedule for the various defense agencies, and (3) we reported³ on concerns with the Marine Corps and Navy schedule and cost estimating practices in July 2008 and September 2008, respectively. In performing our analysis for the four ERPs, we reviewed the schedules and cost estimates available at the time of our review and evaluated them using the criteria set forth in GAO's cost guide.⁴ In using the guide, we determined the extent to which each schedule was prepared in accordance with the best practices⁵ that are fundamental to having a reliable schedule. In assessing each program's cost estimates, we used the GAO cost guide to evaluate the PMOs' estimating methodologies, assumptions, and results to determine whether the cost estimates were comprehensive, accurate, well-documented, and credible. We discussed the results of our assessments with the PMOs, lead schedulers, and cost estimators.

²GAO-10-461, GAO-09-841, GAO-08-896, GAO-08-866, GAO-08-822, and GAO-07-860.

³GAO-08-822 and GAO-08-896.

⁴GAO-09-3SP.

⁵GAO-09-3SP.

To address the third objective, we obtained and reviewed the 2009 and 2010 reports⁶ on business transformation submitted to congressional defense committees by each military service to determine the extent to which these reports included performance measures. In addition, we met with the military departments' deputy chief management officers to obtain an understanding of how they define success in terms of their respective ERPs. We also met with the personnel within the department's DCMO office and the Director, Business Transformation Agency, to obtain an understanding of their respective roles and responsibilities for the implementation of the ERPs within the department.

We conducted this performance audit from June 2009 through October 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

⁶United States Army, *2009 United States Army Report to Congress* (Arlington, Va.), and *2010 Army Report to Congress on Business Transformation* (Arlington, Va.: Mar. 1, 2010); Department of the Navy, *Congressional Report, NDAA 2009, Section 908, Business Transformation Initiatives for the Military Departments* (Arlington, Va.), and *Department of the Navy Fiscal Year 2010 Business Transformation Report Update* (Arlington, Va.); and United States Air Force, *Initial Report on Implementation of NDAA 2009, Business Transformation Initiatives for the Military Departments (Sec 908)* (Arlington, Va.: July 2009), and *March 2010 Follow-up Report on Implementation of NDAA 2009, Business Transformation Initiatives for the Military Departments (Sec 908)* (Arlington, Va.: March 2010).

Appendix II: Comments from the Department of Defense



DEPUTY CHIEF MANAGEMENT OFFICER
9010 DEFENSE PENTAGON
WASHINGTON, DC 20301-9010

SEP 23 2010

Mr. Asif A. Khan
Director, Financial Management and Assurance
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Khan:

The Department of Defense (DoD) response to the U.S. Government Accountability Office (GAO) draft report 10-951, "DOD BUSINESS TRANSFORMATION: Improved Management Oversight of Business System Modernization Needed," dated August 25, 2010 (GAO Code 197086), is contained in this letter. The Department concurs with all GAO recommendations contained in the draft report.

Your audit highlighted the need to incorporate best practices into development of an integrated master schedule (IMS). The Department recognizes IMS as a key program management tool fundamental to program schedule reliability. The appropriate Military Department Chief Management Officers will direct Program Managers to implement these recommendations and have oversight over implementation. Additionally, the Department will issue guidance requiring DoD business systems investments to include performance measures which can be used to assess expected business benefits. For strategic alignment, these measures will also be incorporated into the Business Enterprise Architecture.

Sincerely,

A handwritten signature in black ink, appearing to read "Elizabeth A. McGrath".

Elizabeth A. McGrath



The report number is now
GAO-11-53.

Appendix III: Status of DOD's Actions on Previous GAO Recommendations Related to Business Systems Modernization

Tables 6 through 10 provide information on the status of DOD's actions to address our recommendations in previous reports.

Table 6: Status of DOD's Actions to Address GAO Recommendations in [GAO-07-860](#)

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>1. The Secretary of Defense should direct the Secretary of the Army and the Director, Business Transformation Agency (BTA) to jointly develop a concept of operations that (1) clearly defines the ERP vision for accomplishing total asset visibility (TAV) within the Army; (2) addresses how its business systems and processes, individually and collectively, will provide the desired functionality to achieve total asset visibility; and (3) determines the desired functionality among the selected systems.</p>	<p>The Army's March 2010 report to Congress^a stated that the Army lacks a concept of operations that describes at a high level how the GFEBS, GCSS-Army, and LMP systems relate to each other and how information flows between and through the systems. Furthermore, the Army found that representatives from the three systems were not able to articulate (1) what specific data would be exchanged between the three systems and (2) which system would be considered the official system of record for master data that needed to be consistent between the three systems. The Army did not provide a timeframe for completing the concept of operations.</p>	Open
<p>2. The Secretary of Defense should direct the Secretary of the Army and the Director, BTA to jointly develop policies, procedures, and processes to support the oversight and management of selected groupings of business systems that are intended to provide a specific capability or functionality, such as TAV from a portfolio perspective, utilizing indicators such as costs, schedule, performance, and risks.</p>	<p>In June 2010, the Under Secretary of the Army established the Business Systems Information Technologies Executive Steering Group. The purpose of the group is to advise the Army Chief Management Officer on Army-wide requirements for the synchronization, integration, prioritization, and resourcing of Army business systems. The Army's efforts to establish an enterprisewide focus on systems investments should improve the Army's ability to oversee the billions of dollars it is investing in its business systems. The group meets the intent of the recommendation.</p>	Closed
<p>3. The Secretary of Defense should direct the Secretary of the Army and the Director, BTA to jointly establish an independent verification and validation (IV&V) function for GFEBS, GCSS-Army, and LMP. Additionally, direct that all IV&V reports for each system be provided to Army management, the appropriate investment review board (IRB), and BTA.</p>	<p>In August 2009, the Army awarded a contract to carry out the IV&V function for these systems. Under the contract, the contractor is to provide reports on each of the systems to the Program Executive Office Enterprise Information Systems, which reports to the Army's Deputy Chief Management Officer (DCMO). The Army's action to establish an IV&V function under the direction of the Army's DCMO, if fully and effectively implemented, should enable the Army to improve its management and oversight of its business systems investments.</p> <p>Given the responsibility of the Chief Management Officer for overseeing and monitoring the implementation of Army's business systems, the Army's action meets the intent of the recommendation.</p>	Closed
<p>4. The Secretary of Defense should direct the Secretary of the Army and the Director, BTA to jointly require that any future GFEBS economic analysis identify costs and benefits in accordance with the criteria specified by DOD and Office of Management and Budget (OMB) guidance, to include a sensitivity analysis.</p>	<p>While the Army has developed an updated economic analysis, it was not prepared in accordance with DOD and OMB guidance.^b For example, the economic analysis did not include a sensitivity analysis or a cost uncertainty analysis. Cost estimates should discuss any limitations of the analysis because of uncertainty or biases surrounding data and assumptions. Major assumptions should be varied, and other outcomes recomputed to determine how sensitive they are to changes in the assumptions. Having a range of costs around a point estimate—the best guess at the cost estimate, given the underlying data—is more useful to</p>	Open

**Appendix III: Status of DOD's Actions on
Previous GAO Recommendations Related to
Business Systems Modernization**

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
5. The Secretary of Defense should direct the Secretary of the Army and the Director, BTA to jointly direct that LMP utilize system testers that are independent of the LMP system developers to help ensure that the system is providing the users of the system the intended capabilities.	<p>decision makers because it conveys the level of confidence in achieving the most likely cost and also informs management on cost, schedule, and risks.</p> <p>The Army has stated that LMP system testers are now independent of the system developers. We are in the process of evaluating the Army's actions as part of our ongoing work on the third deployment of LMP.</p>	Open

Source: GAO analysis of data provided by DOD.

^aU.S. Army, *Report to Congress on Business Transformation* (Mar. 1, 2010).

^bDepartment of Defense Instruction 7041.3 and OMB Circular No. A-94.

**Appendix III: Status of DOD's Actions on
Previous GAO Recommendations Related to
Business Systems Modernization**

Table 7: Status of DOD's Actions to Address GAO Recommendations in [GAO-08-822](#)

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>1. The Secretary of Defense direct the Secretary of the Navy to ensure that investment in the next acquisition phase of the program's first increment is conditional upon fully disclosing to program oversight and approval entities the steps under way or planned to address each of the risks discussed in the report, including the risk of not being architecturally compliant and being duplicative of related programs, not producing expected mission benefits commensurate with reliably estimated costs, not effectively implementing earned valued management (EVM), not mitigating known program risks, and not knowing whether the system is becoming more or less mature and stable. We further recommend that investment in all future Global Combat Support System-Marine Corps (GCSS-MC) increments be limited if the management control weaknesses that are the source of these risks, and which are discussed in the report, have not been fully addressed.</p>	<p>An Enterprise Risk Assessment Methodology (ERAM)-based review was conducted on GCSS-MC, and the results were presented at a May 2009 IRB meeting. According to DOD, the assessment included a review of the program's risk management database and policies. The ERAM process identified seven risk areas, some of which relate to risks discussed in our report. DOD reported that the governance-related risks identified in our report require longer-term actions; while the program had nevertheless demonstrated compliance with its business enterprise architecture and that the IRB reviewed and certified compliance with the architecture in October 2009. DOD also reported that the program implemented a new risk management process in March 2009 and developed metrics related to system maturity and stability, such as metrics to track defects during developmental test and evaluation, and is tracking change requests and generating monthly trend analyses of each. In addition, DOD reported that the program is working closely with the Milestone Decision Authority, via the IRB, to correct management control weaknesses. As of October 2010, DOD had yet to provide the supporting documentation for the above actions taken by the department.</p>	Open
<p>2. The Secretary of Defense direct the appropriate organization within DOD to collaborate with relevant organizations to standardize the cost element structure for the department's ERP programs and to use this standard structure to maintain cost data for its ERP programs, including GCSS-MC, and to use this cost data in developing future cost estimates.</p>	<p>In April 2010, DOD reported that planning is underway within the BTA and the Office of Acquisition Resources and Analysis for development of a common set of high-level work elements, such as testing, design, and training, to augment detailed work breakdown structures developed by program managers for their respective ERP programs. DOD also stated that it plans to use the common set of high-level work elements, along with a common set of cost elements—buckets of cost types such as program management, technical labor, hardware, and software—to capture historical costs across ERP programs. DOD also stated that it still plans to track and maintain ERP cost data through the Business Capability Lifecycle Integrated Management Information Environment, and use the data to develop future cost estimates and an economic analysis. As of October 2010, DOD did not provide timeframes for completion of these actions.</p>	Open
<p>3. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that the program's current economic analysis is adjusted to reflect the risks associated with it not reflecting cost data for comparable ERP programs, and otherwise not having been derived according to other key cost estimating practices, and that future updates to the GCSS-MC economic analysis similarly do so.</p>	<p>In April 2010, DOD reported that the GCSS-MC program developed its Cost Analysis Requirements Document and Economic Analysis Development Plan in partnership with the Office of the Secretary of Defense (Cost Analysis and Program Evaluation) to ensure that the GCSS-MC economic analysis addresses DOD-wide assumptions and risks. DOD stated that the independent cost estimate prepared by the Naval Center for Cost Analysis and approved in January 2010 was risk adjusted and included cross-checks from similar ERP systems and models. As of October 2010, DOD had yet to provide the supporting documentation for the above actions.</p>	Open

**Appendix III: Status of DOD's Actions on
Previous GAO Recommendations Related to
Business Systems Modernization**

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>4. To enhance GCSS-MC's use of EVM, we recommend that the Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that the program office (1) monitors the actual start and completion dates of work activities performed so that the impact of deviations on downstream scheduled work can be proactively addressed; (2) allocates resources, such as labor hours and material, to all key activities on the schedule; (3) integrates key activities and supporting tasks and subtasks; (4) identifies and allocates the amount of float time needed for key activities to account for potential problems that might occur along or near the schedule's critical path; (5) performs a schedule risk analysis to determine the level of confidence in meeting the program's activities and completion date; (6) allocates schedule reserve for high-risk activities on the critical path; and (7) discloses the inherent risks and limitations associated with any future use of the program's EVM reports until the schedule has been risk-adjusted.</p>	<p>In April 2010, DOD reported that the schedule was rebaselined and is now used to monitor and report actual versus planned start and completion dates of work activities; allocate resources to activities; integrate key activities and supporting tasks and sub-tasks; identify and allocate the amount of float time needed for key activities, and allocate schedule reserve for high-risk activities on the critical path. DOD also reported that the program conducted a schedule risk analysis which resulted in more detailed task definitions, the ability to provide detailed weekly status reports to the program manager, and more effective analysis, monitoring and risk assessment of the program's scheduled activities and completion dates. As of October 2010, DOD had yet to provide the supporting documentation for the above actions.</p>	Open
<p>5. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that the program office (1) adds each of the risks discussed in this report to its active inventory of risks, (2) tracks and evaluates the implementation of mitigation plans for all risks, (3) discloses to appropriate program oversight and approval authorities whether mitigation plans have been fully executed and have produced the intended outcome(s), and (4) only closes a risk if its mitigation plan has been fully executed and produced the intended outcome(s).</p>	<p>In April 2010, DOD reported that the program office took a number of actions to strengthen risk management. First, it included all risks reported by GAO as well as risks identified through DOD's ERAM in its risk database. Second, program risks are now reviewed, tracked and managed on a continuous basis, and the program office conducts weekly risk meetings to track and evaluate mitigation plan implementation for all risks. Third, monthly risk boards are convened to discuss risks and mitigation plans with GCSS-MC senior leadership, and risks are not closed without risk board approval. Further, the program office meets monthly with the Program Executive Office for Enterprise Information Systems and quarterly with the Assistant Secretary of the Navy (Research Development and Acquisition) to discuss program risks. Also, the program office reports risks to other program oversight bodies, such as the Weapons Systems Lifecycle Management and Materiel Supply and Services Management IRB, and the Defense Business Systems Management Committee. Fourth, the program office revised its Risk Management Plan, in March 2009, to reflect these new processes and policies. As of October 2010, DOD had yet to provide the supporting documentation for the above actions.</p>	Open

**Appendix III: Status of DOD's Actions on
Previous GAO Recommendations Related to
Business Systems Modernization**

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>6. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that the program office (1) collects the data needed to develop trends in unresolved system defects and change requests according to their priority and severity and (2) discloses these trends to appropriate program oversight and approval authorities.</p>	<p>In April 2010, DOD reported that during system developmental test and evaluation, completed in October 2009, the program office developed metrics to track defects and correction of defects throughout the test period, and that the metrics were made available to the BTA and the Cost Analysis and Program Evaluation Office. DOD reported that the program office is also (1) collecting defect data over time across severity levels and using diagrams to show trends and (2) managing change requests according to its configuration management plan and generating trend analysis reports to track them. As of October 2010, DOD had yet to provide the supporting documentation for the above actions.</p>	Open

Source: GAO analysis of data provided by DOD.

**Appendix III: Status of DOD's Actions on
Previous GAO Recommendations Related to
Business Systems Modernization**

Table 8: Status of DOD's Actions to Address GAO Recommendations in [GAO-08-866](#)

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>1. The Secretary of Defense direct the Secretary of the Air Force to direct Air Force program management officials for ECSS and DEAMS to ensure that risk management activities at all levels of the program are identified and communicated to program management to facilitate oversight and monitoring. Key risks described at the appropriate level of detail should include and not be limited to risks associated with interfaces, data conversion, change management, and contractor oversight.</p>	<p>In July 2009, the DEAMS Program Charter noted that risk management activities at all levels of the program would be identified and communicated to the program manager to facilitate oversight and monitoring. The charter noted that program risk will include, but not be limited to, interfaces, data conversion, change management, and contractor oversight. The charter also notes that the risk management process will include risk identified by various reviews, including GAO audits. As of July 2010, ECSS was still in the process of revising its risk management plan to address our recommendation.</p>	Open
<p>2. The Secretary of Defense direct the Secretary of the Air Force to direct the Air Force program management offices to test ECSS and DEAMS on relevant computer desktop configurations prior to deployment at a given location.</p>	<p>The intent of the recommendation was to reduce program risk and ensure that when DEAMS and ECSS were deployed to a given location they would operate as intended. According to the DEAMS PMO, the PMO has performed appropriate testing prior to the system being operational and if necessary, changes are made prior to the implementation of the system. The Defense Finance and Accounting Service is also participating in the testing, thereby helping to ensure that the accounting information will process correctly. As of July 2010, ECSS had not yet become operational at a given location.</p>	Open

Source: GAO analysis of data provided by DOD.

**Appendix III: Status of DOD's Actions on
Previous GAO Recommendations Related to
Business Systems Modernization**

Table 9: Status of DOD's Actions to Address GAO Recommendations in [GAO-08-896](#)

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>1. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that future Navy ERP estimates include uncertainty analyses of estimated benefits, reflect the risks associated with not having cost data for comparable ERP programs, and are otherwise derived in full accordance with the other key estimating practices, and economic analysis practices discussed in this report.</p>	<p>In July 2010, DOD reported that uncertainty analysis will be applied to the Navy ERP's benefit estimate in support of the next milestone review, Full Deployment Decision Review, planned for the first quarter of fiscal year 2011. The benefit estimation model is being updated to include variations among key cost drivers, such as labor category efficiency and legacy system sustainment difficulty factors, through the use of Monte Carlo simulation. In addition, DOD reported that the Navy ERP program is working with the Space and Naval Warfare Systems Command and Naval Center for Cost Analysis, as they conduct an independent assessment of the program's life-cycle cost estimate. According to DOD, the assessment will include a review of the risk/uncertainty approach and methodologies used to develop the cost estimate.</p>	Open
<p>2. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that (1) an integrated baseline review on the last two releases of the first increment is conducted, (2) compliance against the 32 accepted industry earned value management (EVM) practices is verified, and (3) a plan to have an independent organization perform surveillance of the program's EVM system is developed and implemented.</p>	<p>In July 2010, DOD reported that the Navy ERP program office conducted an integrated baseline review of its second release, which resulted in recommendations to mature and implement EVM processes. Because the third release is no longer a part of Navy ERP's program of record, this recommendation is not applicable to this release. In addition, DOD reported that the Navy Center for Earned Value Management planned to conduct surveillance of the Navy ERP's EVM system in September 2010, and that it would review compliance against the 32 accepted industry EVM practices.</p>	Open
<p>3. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that the schedule (1) includes the logical sequencing of all activities, (2) reflects whether all required resources will be available when needed, (3) defines a critical path that integrates all three releases, (4) allocates reserve for the high-risk activities on the entire program's critical path, and (5) incorporates the results of a schedule risk analysis for all three releases and recalculates program cost and schedule variances to more accurately determine a most likely cost and schedule overrun.</p>	<p>As of July 2010, Navy ERP continues to make progress in addressing this recommendation. For example, it is using metrics to track and logically link activities and account for resources and their availability, and it plans to conduct a schedule risk assessment in September 2010 so that reserves can be established for high-risk activities. Further, in July 2010, DOD reported that it was not feasible to define a critical path integrating all three releases because (1) key functionality deliverables for the first release were completed prior to the second release's development and (2) the third release was removed from Navy ERP's program of record. However, the March 2010 metrics report shows that not all activities are logically sequenced, which can affect the calculation of the critical path and finish date. Further, because the schedules are not integrated and personnel are assigned to activities across multiple releases, if deployment activities in one schedule were to be delayed, the other schedule that requires the same resources would likely also be delayed.</p>	Open

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GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>4. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to ensure that (1) the plans for mitigating the risks associated with converting data from legacy systems to Navy ERP and positioning the commands for adopting the new business processes embedded in the Navy ERP are re-evaluated in light of the recent experience with the Naval Air Systems Command (NAVAIR) and adjusted accordingly, (2) the status and results of these and other mitigation plans' implementation are periodically reported to program oversight and approval authorities, (3) these authorities ensure that those entities responsible for implementing these strategies are held accountable for doing so, and (4) each of the risks discussed in this report are included in the program's inventory of active risks and managed accordingly.</p>	<p>The department has taken actions to address the intent of this recommendation. First, the Navy ERP program office reevaluated its plans for mitigating risks associated with data conversion and adopting new business processes. Second, the program manager and System Command officials report monthly to the Navy ERP Senior Integration Board (NESIB) on performance, and periodically brief oversight and approval authorities on the implementation of risk mitigation plans. Third, the NESIB requires actionable reporting on performance by the program manager and System Command officials, and the program manager is to report to the Milestone Decision Authority on implementation of risk mitigation strategies. Fourth, the program's risk inventory has been updated to include risks related to adopting new business processes and data conversion.</p>	<p>Closed</p>

Source: GAO analysis of data provided by DOD.

**Appendix III: Status of DOD's Actions on
Previous GAO Recommendations Related to
Business Systems Modernization**

Table 10: Status of DOD's Actions to Address GAO Recommendations in [GAO-09-841](#)

GAO recommendation	DOD action taken to address the recommendation	Status of GAO recommendation
<p>1. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to (1) revise the Navy ERP procedures for controlling system changes to explicitly require that a proposed change's life-cycle cost impact be estimated and considered in making change request decisions and (2) capture the cost and schedule impact of each proposed change in the Navy ERP automated control tracking tool.</p>	<p>The Navy ERP program updated its Enterprise Change Request Process and Procedures to explicitly require that a change's life-cycle cost impact be estimated as part of the change control process. In addition, the change control tracking tool now captures cost and schedule impact information. As a result, management of the Navy ERP's change control process has been strengthened. As a result, approval authorities should be provided key information needed to fully inform their decisions on whether to approve a change, thus decreasing the risk of unwarranted cost increases and schedule delays.</p>	<p>Closed</p>
<p>2. The Secretary of Defense direct the Secretary of the Navy, through the appropriate chain of command, to (1) stop performance of the IV&V function under the existing contract and (2) engage the services of an IV&V agent that is independent of all Navy ERP management, development, testing, and deployment activities that it may review.</p>	<p>According to DOD, the Navy ERP program office terminated the IV&V functions under the existing contract on September 30, 2009, and awarded a new IV&V contract in September 2010.</p>	<p>Closed</p>

Source: GAO analysis of data provided by DOD.

Appendix IV: Assessments of Four DOD ERP Programs' Integrated Master Schedules

This appendix provides the results of our analysis of the extent to which the processes and methodologies used to develop and maintain the four ERP integrated master schedules meet the nine best practices associated with effective schedule estimating.¹ Tables 11, 12, 13, 14, and 15 provide the detailed results of our analyses of the program schedules for DEAMS, ECSS, GFEBs, and GCSS-Army compared to the nine best practices.

“Not met” means the program provided no evidence that satisfies any of the criterion. “Minimally” means the program provided evidence that satisfies a small portion of the criterion. “Partially” means the program provided evidence that satisfies about half of the criterion. “Substantially” means the program provided evidence that satisfies a large portion of the criterion. “Fully met” means the program provided evidence that completely satisfies the criterion.

Table 11: Analysis of the Air Force’s DEAMS Program Schedule

Best practice	Explanation	Criterion met	GAO analysis
1. Capturing all activities	The schedule should reflect all activities as defined in the project’s work breakdown structure, which defines in detail the work necessary to accomplish a project’s objectives, including activities to be performed by both the owner and contractors.	Partially	Our analysis found that the DEAMS program schedule is not fully integrated. While the DEAMS PMO maintains internal schedules that reflect government-only activities, these government schedules have no links to activities within the contractor schedule. We found that activities in the contractor schedule are mapped to contract line item numbers and assigned to integrated product teams, but many activities are missing contractor work breakdown structure mappings. PMO officials told us that because of the firm-fixed price (FFP) nature of the current contract, the prime contractor is not obligated to provide detailed insight into the contractor schedule. Instead, the PMO uses the contractor schedule as a starting point to develop more detailed internal tools, such as lower-level schedule information maintained in spreadsheets. But without government activities fully integrated with contractor activities, we cannot guarantee that the schedule has either adequately captured all key activities necessary for the program’s completion or that the PMO can reliably estimate the finish date for the program.

¹GAO-09-3SP.

Appendix IV: Assessments of Four DOD ERP Programs' Integrated Master Schedules

Best practice	Explanation	Criterion met	GAO analysis
2. Sequencing all activities	The schedule should be planned so that critical project dates can be met. To meet this objective, activities need to be logically sequenced—that is, listed in the order in which they are to be carried out. In particular, activities that must be completed before other activities can begin (predecessor activities), as well as activities that cannot begin until other activities are completed (successor activities), should be identified. This helps ensure that interdependencies among activities that collectively lead to the accomplishment of events or milestones can be established and used as a basis for guiding work and measuring progress.	Minimally	<p>Our analysis of the DEAMS contractor schedule shows that 131 of the 273 remaining activities, or 48 percent, have missing predecessor or successor logic. Missing predecessors or successors reduce the credibility of the calculated dates. If an activity that has no logical successor slips, the schedule will not reflect the effect on the critical path, float, or scheduled start dates of downstream activities. In addition, we found that 42 remaining activities, or 15 percent, have “dangling” logic—that is, these activities whose start or finish dates are missing logic. Of these 42 activities with dangling logic, 37 activities are missing logic that would determine their start dates. Because their start dates are not determined by logic, these activities would have to start earlier in order to finish on time if they ran longer than their planned durations. The other 5 activities with dangling logic are missing successors off their finish date. In other words, these activities could continue indefinitely and not affect the start or finish dates of future activities.</p> <p>We found six remaining activities with start-to-finish links. Start-to-finish links are rarely, if ever, used because they have the odd effect of causing a successor to finish before its predecessor.^a We also found 18 links to or from summary tasks. Summary tasks should not have dependencies because they take their start date, finish date, and duration from lower-level activities.</p> <p>In addition, we found 50 remaining activities (18 percent) with Start No Earlier Than constraints. These are considered “soft” date constraints in that they allow the activity to slip into the future based on what happens to their predecessor activities. While activities may be soft constrained, for example, to represent receipt of delivery of equipment, in general constraining an activity’s start date prevents managers from accomplishing work as soon as possible and consumes flexibility in the project.</p> <p>Of the remaining activities, 47 activities are linked to their successor activities with lags, including lags that are greater than 100 days. Lags represent the passing of time between activities but are often misused to put activities on a specific date or to insert a buffer for risk. Lags should be justified because they cannot vary with risk or uncertainty.</p> <p>PMO officials noted that the contractor schedule follows a Data Item Description (DID) that details the preparation of the schedule. However, the schedule does not meet the requirements set forth in the DID. For example, the DID states that the schedule “shall be an integrated, logical network-based schedule” and that a key element of the schedule is the “relationship/dependency” of an activity. Without logically sequencing activities, the schedule cannot be used as a reliable basis for guiding work and measuring progress.</p>

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Best practice	Explanation	Criterion met	GAO analysis
3. Assigning resources to all activities	The schedule should reflect what resources (e.g., labor, materials, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist.	Fully met	Because of the current FFP contractual arrangement, the government does not have insight into the contractor's efforts to assign resources to activities. However, contractor officials provided evidence that resources have been assigned to activities within their schedule. In addition, PMO officials assign and monitor individual government resources to lower-level activities that are updated in internal tools outside the delivered contractor schedule.
4. Establishing the duration of all activities	The schedule should realistically reflect how long each activity will take to execute. In determining the duration of each activity, the same rationale, historical data, and assumptions used for cost estimating should be used. Durations should be as short as possible and have specific start and end dates. The schedule should be continually monitored to determine when forecasted completion dates differ from planned dates; this information can be used to determine whether schedule variances will affect subsequent work.	Substantially	The majority of remaining activities in the contractor schedule meet best practices for durations. There are 50 activities (18 percent) with planned durations longer than 44 days, which exceeds the best practice for activity duration. ^b There are 7 (3 percent) level-of-effort activities with durations greater than 1,200 days. These level-of-effort activities drive the end date of the project and hence adversely affect the calculation of the critical path—the longest duration path through the sequenced list of activities. Level-of-effort activities, such as systems engineering and program management, should not define the critical path because they are nondiscrete support activities that do not produce a definite end product.

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Best practice	Explanation	Criterion met	GAO analysis
5. Integrating schedule activities horizontally and vertically	The schedule should be horizontally integrated, meaning that it should link products and outcomes associated with other sequenced activities. These links are commonly referred to as “handoffs” and serve to verify that activities are arranged in the right order to achieve aggregated products or outcomes. The schedule should also be vertically integrated, meaning that the dates for starting and completing activities in the integrated master schedule should be aligned with the dates for supporting tasks and subtasks. Such mapping or alignment among levels enables different groups to work to the same master schedule.	Minimally	<p>Vertical integration—that is, the ability to consistently trace work breakdown structure elements between detailed, intermediate, and master schedules—is demonstrated somewhat because of the efforts by the DEAMS PMO to enhance its insight into contractor effort despite the FFP contract environment. PMO officials stated that while the contractor is under no obligation to provide detailed activities in the contractor schedule, the government has broken down areas such as object development and testing into detailed activities with internal tools that allow for weekly monitoring and status checking. However, we could not fully establish the link between the internal updating of activities by the government in lower-level spreadsheets and the high-level schedule delivered by the contractor.</p> <p>Issues with missing dependencies, activities with dangling logic, overuse of lags, and critical level-of-effort activities prevent the contractor schedule from fully complying with the requirement of horizontal integration—that is, the overall ability of the schedule to depict relationships between different program elements and product handoffs. PMO officials stated that rather than using the high-level contractor schedule, government and contractor subject matter experts meet each week to discuss progress on ongoing activities using other internal management tools. If activities are delayed or accelerated, the experts discuss potential impacts to downstream activities and provide management with weekly to daily information on these impacts. But while subject matter experts may understand the impacts of delayed activities, senior decision makers may not be aware of near-critical activities that have the potential to significantly delay the project, nor do they have the proper insight into available float—the amount of time an activity can slip before it delays the finish date of the project—that can be used to mitigate the risk of critical or near-critical activities.</p>

Appendix IV: Assessments of Four DOD ERP Programs' Integrated Master Schedules

Best practice	Explanation	Criterion met	GAO analysis
6. Establishing the critical path for all activities	Scheduling software should be used to identify the critical path, which represents the chain of dependent activities with the longest total duration. Establishing a project's critical path is necessary to examine the effects of any activity slipping along this path. Potential problems along or near the critical path should also be identified and reflected in scheduling the duration of high-risk activities.	Minimally	<p>Our analysis could not determine a valid critical path within the DEAMS contractor schedule, particularly because over 60 percent of remaining activities have missing or incomplete logic, and because level-of-effort activities (over 1,200 days long) define the start and finish dates of the project. Level-of-effort activities, such as systems engineering and program management, should not define the critical path because they are nondiscrete support activities that do not produce a definite end product.</p> <p>PMO officials acknowledged that a critical path cannot be calculated within the schedule and stated that the contractor schedule is used only as a starting point for more detailed internal tracking tools such as spreadsheets. Detail is not available within the contractor schedule because of the current FFP contract with the contractor. PMO officials also stated that establishing a traditional critical path is not possible in a complex ERP environment because there is no one clear path through development or testing. Rather than use the high-level contractor schedule government and contractor subject matter experts meet on a weekly to daily basis to discuss progress on ongoing activities using other internal management tools. If activities are delayed or accelerated, the experts discuss potential impacts to downstream activities and provide management with weekly to daily information on these impacts. But senior decision makers may not be aware of near-critical activities nor have the proper insight into available float that can be used to mitigate the risks associated with these activities. In addition, PMO officials noted that the contractor schedule follows a DID that details the preparation of the schedule. However, the contractor schedule does not meet the requirements set forth in the DID. The DID states a critical path is a key element of the detailed schedule; that "the critical path and near-critical paths are calculated by the scheduling software"; and "the critical path shall be easily identified."</p>
7. Identifying reasonable float	The schedule should identify the float—the amount of time by which a predecessor activity can slip before the delay affects successor activities—so that a schedule's flexibility can be determined. As a general rule, activities along the critical path have the least float. Total float is the total amount of time by which an activity can be delayed without delaying the project's completion, if everything else goes according to plan.	Minimally	<p>Our analysis found that float calculations within the DEAMS contractor schedule are not reliable because of the improper linking of summary tasks. In addition, because the schedule is missing dependencies, float estimates will be miscalculated because float is directly related to the logical sequencing of events. PMO officials told us that internal activity tracking and monitoring tools used in lieu of the detailed contractor activities do not allow insight into float calculations.</p> <p>PMO officials noted that the contractor schedule follows a DID that details the preparation of the schedule. However, the contractor schedule does not meet the requirements set forth in the DID. The DID states total float is a key element of the detailed schedule to be delivered monthly. Without float estimates management may be unable to allocate resources from non-critical activities to activities that cannot slip without affecting the project finish date.</p>

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Best practice	Explanation	Criterion met	GAO analysis
8. Conducting a schedule risk analysis	A schedule risk analysis should be performed using statistical techniques to predict the level of confidence in meeting a project's completion date. This analysis focuses not only on critical path activities but also on activities near the critical path, since they can affect the project's status.	Minimally	<p>The program office has not performed a schedule risk analysis on the schedule because the schedule is not used as a primary tool for monitoring the status of the program. However, program officials stated that they have tied risks to what subject matter experts consider to be critical path activities. They stated that they proactively monitor risk on a weekly basis by assigning a probability to the risk, examining the potential impact of the risk on activities if it is realized, and developing mitigation plans to be executed if the risk is realized. However, the risk assessments cannot be used to calculate the overall probability of finishing the project on time. Since any task can become critical if it is delayed long enough, complete schedule logic and a comprehensive risk assessment are essential tools for decision makers. A schedule risk analysis can be used to determine a level of confidence in meeting the completion date or whether proper reserves have been incorporated into the schedule. A schedule risk analysis will calculate schedule reserve, which can be set aside for those activities identified as high risk. Without this reserve, the program faces the risk of delays to the scheduled completion date if any delays were to occur on critical path activities.</p> <p>In addition, PMO officials noted that the contractor schedule follows a DID that details the preparation of the schedule. However, the contractor schedule does not meet the requirements set forth in the DID. The DID states that a key element of the detailed schedule is a schedule risk analysis that "predicts the probability of project completion by contractual dates" using three-point estimates about the remaining durations of remaining activities.</p>

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Best practice	Explanation	Criterion met	GAO analysis
9. Updating the schedule using logic and durations to determine the dates	The schedule should be continuously updated using logic and durations to determine realistic start and completion dates for program activities. The schedule should be analyzed continuously for variances to determine when forecasted completion dates differ from planned dates. This analysis is especially important for those variations that impact activities identified as being in a project's critical path and can impact a scheduled completion date.	Minimally	<p>Our analysis shows the contractor schedule does not have a status date (or data date), nor did the program office expect one. A status date denotes the date of the latest update to the schedule and thus defines the point in time at which completed work and remaining work are calculated. Officials stated that the status date is reflected by the month in the schedule file name; but because no day is given there is no indication whether the date reflects the beginning or end of the calendar month or beginning or end of the contractor accounting period. Regardless of the exact date, we found 31 activities that had actual starts in future months relative to the month in the file name. That is, according to the schedule, these activities had actually started in the future. For example, the schedule file name is November 2009, yet we found actual start dates for activities in December 2009, February 2010, and April 2010.</p> <p>PMO officials noted that the contractor schedule follows the DID that details the preparation of the schedule. However, the contractor schedule does not meet the requirements set forth in the DID. The DID states that "actual start and actual finish dates, as recorded, shall not be later than the status date."</p> <p>PMO officials stated that rather than use the high-level contractor schedule, which does not give the required activity detail, government and contractor subject matter experts meet on a weekly to daily basis to discuss progress on ongoing activities using other internal management tools. For example, the Testing Integrated Product Team meets daily to review tasks that have been performed that day. If deadline criteria are not met, senior decision makers are alerted to potential impacts to the schedule. However, the schedule should use logic and durations in order to reflect realistic start and completion dates for program activities. The schedule should also be continually monitored to determine when forecasted completion dates differ from the planned dates, which can be used to determine whether schedule variances will affect downstream work. Maintaining the integrity of the schedule logic is not only necessary to reflect true status, but is also required before conducting a schedule risk analysis.</p>

Source: GAO analysis based on data provided by the DEAMS PMO.

^aActivities need to have certain predecessor-successor relationships so the schedule gives the correct results when they are updated or when durations change. Two logic requirements have to be provided: (1) a finish-to-start or start-to-start predecessors, so that if the activity is longer than scheduled it does not just start earlier automatically, and (2) finish-to-start or finish-to-finish successors that will be "pushed" if they take longer or finish later.

^bThe Naval Air Systems Command recommends keeping individual task durations to less than two calendar months (44 working days). The shorter the duration of the tasks in the schedule, the more often the Control Account Managers are compelled to update completed work which more accurately reflects the actual status of the tasks. When task durations are too long, management insight into the actual status of the activity is reduced.

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Table 12: Analysis of the Air Force's ECSS Solutions Development Project Schedule

Best practice	Explanation	Criterion met	GAO analysis
1. Capturing all activities	The schedule should reflect all activities as defined in the project's work breakdown structure, which defines in detail the work necessary to accomplish a project's objectives, including activities to be performed by both the owner and contractors.	Substantially	While the PMO does have detailed schedules of government effort—a commendable best practice—these are not fully integrated into an integrated master schedule (IMS) with the contractor schedules. Our analysis found that the ECSS Solutions Development schedule contains 215 detail activities associated with government effort, representing dependencies between contractor and government activities. However, the government activities are not completely linked to government schedules maintained and updated by the government PMO. Our analysis found that activities in the Solutions Development workstream schedule are mapped to contractor work breakdown structure elements and can be traced to completion criteria and descriptions of associated work products.

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Best practice	Explanation	Criterion met	GAO analysis
2. Sequencing all activities	The schedule should be planned so that critical project dates can be met. To meet this objective, activities need to be logically sequenced—that is, listed in the order in which they are to be carried out. In particular, activities that must be completed before other activities can begin (predecessor activities), as well as activities that cannot begin until other activities are completed (successor activities), should be identified. This helps ensure that interdependencies among activities that collectively lead to the accomplishment of events or milestones can be established and used as a basis for guiding work and measuring progress.	Partially	<p>Our analysis shows that 31 of the 1,901 remaining activities, or 2 percent, have missing predecessor or successor logic. This is a relatively low number for such a highly integrated schedule, but any number of missing predecessors or successors can reduce the credibility of calculated dates. If an activity that has no logical successor slips, the schedule will not reflect the effect on the critical path, float, or scheduled start dates of future activities. However, of those remaining activities that have logical predecessor and successor links, 259 activities (14 percent), have “dangling logic.” Of these 259 activities with dangling logic, 229 activities are missing logic that would determine their start dates. Because their start dates are not determined by logic, these activities would have to start earlier in order to finish on time if they ran longer than their planned durations. The other 30 activities with dangling logic are missing successors off their finish date. In other words, these activities could continue indefinitely and not affect the start or finish dates of downstream activities.</p> <p>The schedule includes four Must Finish On constraints. A Must Finish On constraint is considered a “hard” date constraint because it prevents the activity from finishing earlier or later than its planned date. This renders the schedule rigid and prevents the schedule from being dynamic. A Must Finish On constraint is artificial and makes the scheduled activity appear to be on track to finish on time when it may not be. There are also 17 Start No Earlier Than constraints within the schedule. These are considered “soft” constraints in that they allow the activity to slip into the future based on what happens to their predecessor activities. Activities may be soft constrained, for example, to represent receipt of delivery of equipment. However, in general constraining an activity’s start date prevents managers from accomplishing work as soon as possible and consumes flexibility in the project.</p> <p>We found 78 start-to-finish links within the schedule. Start-to-finish links are rarely, if ever, used in scheduling practice because they have the odd effect of causing a successor activity to finish when its predecessor starts. Moreover, we found that each of the 78 start-to-finish links have 3-to 7-day lags. That is, the schedule logic dictates that these successors must finish a set number of days before their predecessors begin. Start-to-finish logic is at best confusing and at worst incorrect; activities should be rearranged to find true predecessors and successors and linked with straightforward logic.</p> <p>Of the 1,901 remaining activities, 467 activities are linked to their successor activities with lags. Lags represent the passing of time between activities but are often misused to put activities on a specific date or to insert a buffer for risk. Lags should be justified because they cannot have risk or uncertainty. Without logically sequencing activities, the schedule cannot be used as a reliable basis for guiding work and measuring progress.</p>

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Best practice	Explanation	Criterion met	GAO analysis
3. Assigning resources to all activities	The schedule should reflect what resources (e.g., labor, materials, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist.	Minimally	The ECSS PMO stated that the government is aware that the contractor assigns resources to activities, but the government has no detailed insight into the resources because of the current FFP contractual arrangement. However, the program office was not able to provide evidence that would confirm that the schedule is resource loaded. Resource information would assist the program office in forecasting the likelihood of activities being completed based on their projected end dates. If the current schedule does not allow for insight into current or projected over-allocation of resources, then the risk of the program slipping is significantly increased.
4. Establishing the duration of all activities	The schedule should realistically reflect how long each activity will take to execute. In determining the duration of each activity, the same rationale, historical data, and assumptions used for cost estimating should be used. Durations should be as short as possible and have specific start and end dates. The schedule should be continually monitored to determine when forecasted completion dates differ from planned dates; this information can be used to determine whether schedule variances will affect subsequent work.	Substantially	Eighty-eight percent of remaining activities meet best practices for durations, being less than 44 days (or two working months). Seventy activities (4 percent) have longer than 100-day durations; the PMO has identified the majority of these as level-of-effort support activities. Twenty-five of these level-of-effort activities span the start and end dates of the project and appear in the schedule as critical activities. Level-of-effort activities, such as systems engineering and program management, cannot define the critical path because they are nondiscrete support activities that do not produce a definite end product.

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Best practice	Explanation	Criterion met	GAO analysis
5. Integrating schedule activities horizontally and vertically	The schedule should be horizontally integrated, meaning that it should link products and outcomes associated with other sequenced activities. These links are commonly referred to as “handoffs” and serve to verify that activities are arranged in the right order to achieve aggregated products or outcomes. The schedule should also be vertically integrated, meaning that the dates for starting and completing activities in the integrated master schedule should be aligned with the dates for supporting tasks and subtasks. Such mapping or alignment among levels enables different groups to work to the same master schedule.	Partially	We found that vertical integration—that is, the ability to consistently trace work breakdown structure elements between detailed, intermediate, and master schedules—is demonstrated because the overall ECSS schedule is made up of individual project schedules like the Solutions Development schedule. However, issues with reliance on hard date constraints, the overuse of lags, critical level-of-effort tasks, and instances of convoluted logic such as start-to-finish links keep this detailed schedule from fully complying with the requirement of horizontal integration—that is, the overall ability of the schedule to depict relationships between different program elements and product handoffs. Horizontal integration demonstrates that the overall schedule is rational, planned in a logical sequence, accounts for interdependencies between work and planning packages, and provides a way to evaluate current status.
6. Establishing the critical path for all activities	Scheduling software should be used to identify the critical path, which represents the chain of dependent activities with the longest total duration. Establishing a project’s critical path is necessary to examine the effects of any activity slipping along this path. Potential problems along or near the critical path should also be identified and reflected in scheduling the duration of high-risk activities.	Partially	Our analysis could not determine a valid critical path—the longest duration path through the sequenced list of activities—because level-of -effort activities define the start and finish dates of the detail planning portion of the project. Level of effort activities should not drive the critical path because they only serve to support detail work activities. The PMO acknowledged that a critical path would be difficult to calculate within the schedule because the project schedules are team-oriented rather than product-oriented, which causes complex linking relationships. While a true critical path does not exist throughout all 46 project schedules, program management reviews a high-level, manually constructed “Critical Events” schedule that tracks the status of major program milestones. These major program milestones are linked to lower-level schedules, and their status is updated daily and reviewed each week by program management. However, it is important that the lower-level schedules include complete logic that addresses the relationships between predecessor and successor activities, because any activity can become critical under some circumstances. Without clear insight into a critical path at the project level, management will not be able to monitor critical or near-critical detail activities that may have a detrimental impact on downstream activities if delayed.

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Best practice	Explanation	Criterion met	GAO analysis
7. Identifying reasonable float	The schedule should identify the float—the amount of time by which a predecessor activity can slip before the delay affects successor activities—so that a schedule's flexibility can be determined. As a general rule, activities along the critical path have the least float. Total float is the total amount of time by which an activity can be delayed without delaying the project's completion, if everything else goes according to plan.	Partially	Most remaining tasks appear to have reasonable total float, but there are 587 activities (31 percent) with over 50 days (2 working months) of total float. In other words, according to the schedule, 587 remaining activities (20 percent) could be delayed by 2 working months and not delay the final activity in the Solutions Development schedule. Activities with large float values may indicate a lack of completeness in the schedule logic. The PMO stated that total float is monitored by management in higher-level milestone schedules, not lower-level project schedules. Incorrect float estimates will result in an invalid critical path, and will result in an inability to allocate resources from non-critical activities to activities that cannot slip without affecting the project finish date.
8. Conducting a schedule risk analysis	A schedule risk analysis should be performed using statistical techniques to predict the level of confidence in meeting a project's completion date. This analysis focuses not only on critical path activities but also on activities near the critical path, since they can affect the project's status.	Not met	PMO officials stated that while the program reviews the schedule on a weekly basis and assesses risks to the program, it has not performed a schedule risk analysis. Best practices suggest that a schedule risk analysis can be used to determine a level of confidence in meeting the completion date or whether proper reserves have been incorporated into the schedule. Such an analysis will calculate schedule reserve, which can be set aside for those activities identified as high risk. Without this reserve, the program faces the risk of delays to the scheduled completion date if any delays were to occur in critical path activities.
9. Updating the schedule using logic and durations to determine the dates	The schedule should be continuously updated using logic and durations to determine realistic start and completion dates for program activities. The schedule should be analyzed continuously for variances to determine when forecasted completion dates differ from planned dates. This analysis is especially important for those variations that impact activities identified as being in a project's critical path and can impact a scheduled completion date.	Partially	The status date for the version of the schedule we analyzed is January 1, 2010, a federal holiday. A status date denotes the date of the latest update to the schedule and thus defines the point in time at which completed work and remaining work are calculated. The PMO could not confirm that this date was correct. Assuming the status date is correct, we found several date anomalies within the schedule, suggesting that management may need to review how and when the schedule is updated. We found 29 activities (2 percent) that should have started but have no actual start date; 24 activities (1 percent) that should have finished but have no actual finish date; and 9 milestone activities with actual finish dates in the future. In addition, we found 24 instances (1 percent) of out-of-sequence logic—that is, actual progress being recorded on activities that, according to schedule logic, should not have begun yet. This is a common occurrence in scheduling, as actual events often override planned logic. However, some of these successor activities are planned to begin 2 to 3 months in the future, suggesting that the schedule logic should be updated to reflect changes.

Source: GAO analysis based on data provided by the ECSS PMO.

Note: The ECSS program schedule consists of a master schedule with 46 embedded project schedules representing individual product teams, or workstreams. The 46 schedules include 2 high-level schedules, one dedicated to key date milestones and another to critical events. Two project schedules were chosen based on their importance to the program and the high amount of activity currently associated with the product team.

Table 13: Analysis of the Air Force's ECSS Reports, Interfaces, Conversions, and Extensions (RICE) Program Schedule

Best practice	Explanation	Criterion met	GAO analysis
1. Capturing all activities	The schedule should reflect all activities as defined in the project's work breakdown structure, which defines in detail the work necessary to accomplish a project's objectives, including activities to be performed by both the owner and contractors.	Substantially	<p>While the PMO does have detailed schedules of government effort—a commendable best practice—these are not fully integrated into an integrated master schedule (IMS) with the contractor schedules. Our analysis found that the ECSS RICE schedule contains “touch points,” or links between government and contractor activities, representing dependencies between contractor and government activities. However, the government activities are not completely linked to government schedules maintained and updated by the government PMO.</p> <p>Our analysis found that activities in the RICE workstream schedule are mapped to contractor work breakdown structure elements and can be traced to completion criteria and descriptions of associated work products.</p>
2. Sequencing all activities	The schedule should be planned so that critical project dates can be met. To meet this objective, activities need to be logically sequenced—that is, listed in the order in which they are to be carried out. In particular, activities that must be completed before other activities can begin (predecessor activities), as well as activities that cannot begin until other activities are completed (successor activities), should be identified. This helps ensure that interdependencies among activities that collectively lead to the accomplishment of events or milestones can be established and used as a basis for guiding work and measuring progress.	Partially	<p>Our analysis shows that 472 of the 4,433 remaining activities, or 11 percent, have missing logic. Missing predecessors or successors are usually a signal of broken logic and reduce the credibility of the calculated dates. If an activity that has no logical successor slips, the schedule will not reflect the effect on the critical path, float, or scheduled start dates of future activities. In addition, we found 820 remaining activities, or 19 percent, have “dangling” logic. Of these 820 activities with dangling logic, 241 activities are missing logic that would determine their start dates. Because their start dates are not determined by logic, these activities would have to start earlier in order to finish on time if they ran longer than their planned durations. The other 579 activities with dangling logic are missing successors off their finish date. In other words, these activities could continue indefinitely and not affect the start or finish dates of future activities.</p> <p>We found 277 Start No Earlier Than constraints (6 percent) within the schedule. These are considered “soft” date constraints in that they allow the activity to slip into the future based on what happens to their predecessor activities. Activities may be soft constrained, for example, to represent receipt of delivery of equipment. However, in general constraining an activity's start date prevents managers from accomplishing work as soon as possible and consumes flexibility in the project.</p> <p>Of the remaining activities, 91 activities (2 percent) are linked to their successor activities with lags, including a lag greater than 100 days. Lags represent the passing of time between activities but are often misused to put activities on a specific date or to insert a buffer for risk. Lags should be justified because they cannot have risk or uncertainty. Without logically sequencing activities, the schedule cannot be used as a reliable basis for guiding work and measuring progress.</p>

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Best practice	Explanation	Criterion met	GAO analysis
3. Assigning resources to all activities	The schedule should reflect what resources (e.g., labor, materials, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist.	Minimally	The ECSS PMO stated that the government is aware that the contractor assigns resources to activities, but the government has no detailed insight into the resources because of the current FFP contractual arrangement. However, the program office was not able to provide evidence that would confirm the schedule is resource loaded. Resource information would assist the program office in forecasting the likelihood of activities being completed based on their projected end dates. If the current schedule does not allow for insight into current or projected over-allocation of resources, then the risk of the program slipping is significantly increased.
4. Establishing the duration of all activities	The schedule should realistically reflect how long each activity will take to execute. In determining the duration of each activity, the same rationale, historical data, and assumptions used for cost estimating should be used. Durations should be as short as possible and have specific start and end dates. The schedule should be continually monitored to determine when forecasted completion dates differ from planned dates; this information can be used to determine whether schedule variances will affect subsequent work.	Substantially	Ninety-seven percent of the remaining activities meet best practices for durations, being less than 44 days (or two working months). Sixty activities (1 percent) have longer than 100-day durations, which the PMO has identified as level-of-effort support activities. Forty-two of these level-of-effort activities span the start and end dates of the project and appear in the schedule as critical activities. Level-of-effort activities, such as systems engineering and program management, cannot define the critical path because they are nondiscrete support activities that do not produce a definite end product.
5. Integrating schedule activities horizontally and vertically	The schedule should be horizontally integrated, meaning that it should link products and outcomes associated with other sequenced activities. These links are commonly referred to as "handoffs" and serve to verify that activities are arranged in the right order to achieve aggregated products or outcomes. The schedule should also be vertically integrated, meaning that the dates for starting and completing activities in the integrated master schedule should be aligned with the dates for supporting tasks and subtasks. Such mapping or alignment among levels enables different groups to work to the same master	Partially	We found that vertical integration—that is, the ability to consistently trace work breakdown structure elements between detailed, intermediate, and master schedules—is demonstrated because the overall ECSS schedule is made up of individual project schedules like the RICE schedule. However, issues with missing dependencies, activities with dangling logic, overuse of lags, and critical level-of-effort activities keep this detailed schedule from being fully compliant with the requirement of horizontal integration—that is, the overall ability of the schedule to depict relationships between different program elements and product handoffs. Horizontal integration demonstrates that the overall schedule is rational, planned in a logical sequence, accounts for interdependencies between work and planning packages, and provides a way to evaluate current status.

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Best practice	Explanation	Criterion met	GAO analysis
	schedule.		
6. Establishing the critical path for all activities	<p>Scheduling software should be used to identify the critical path, which represents the chain of dependent activities with the longest total duration. Establishing a project's critical path is necessary to examine the effects of any activity slipping along this path. Potential problems along or near the critical path should also be identified and reflected in scheduling the duration of high-risk activities.</p>	Partially	<p>Our analysis could not determine a valid critical path—the longest duration path through the sequenced list of activities—because nearly 30 percent of remaining activities have missing or incomplete logic, and because level-of-effort tasks (209 days long) define the start and finish dates of the project. Level-of-effort activities should not drive the critical path because they only serve to support detail work activities. The government PMO acknowledged that a critical path would be difficult to calculate within the schedule because the project schedules are team-oriented rather than product-oriented, which causes complex linking relationships. While a true critical path does not exist throughout all 46 project schedules, program management reviews a high-level, manually constructed Critical Events schedule that tracks the status of major program milestones. These major program milestones are linked to lower-level schedules, and their status is updated daily and reviewed each week by program management. However, it is important that the lower level schedules include complete logic that addresses the relationships between predecessor and successor activities, because any activity can become critical under some circumstances. Without clear insight into a critical path at the project level, management will not be able to monitor critical or near-critical detail activities that may have a detrimental impact on downstream activities if delayed.</p>
7. Identifying reasonable float	<p>The schedule should identify the float—the amount of time by which a predecessor activity can slip before the delay affects successor activities—so that a schedule's flexibility can be determined. As a general rule, activities along the critical path have the least float. Total float is the total amount of time by which an activity can be delayed without delaying the project's completion, if everything else goes according to plan.</p>	Partially	<p>We found that the schedule did not have a reasonable amount of float because 78 percent of remaining activities have zero days of total float. In other words, according to the schedule, 3,448 remaining activities cannot slip one day without delaying the finish date of the project by one day. The program lead scheduler stated that total float is monitored by management at the higher critical events schedules, not lower-level project schedules. However, incorrect float estimates in lower-level schedules will result in an invalid critical path, and will result in an inability to allocate resources from non-critical activities to activities that cannot slip without affecting the project finish date.</p>
8. Conducting a schedule risk analysis	<p>A schedule risk analysis should be performed using statistical techniques to predict the level of confidence in meeting a project's completion date. This analysis focuses not only on critical path activities but also on activities near the critical path, since they can affect the project's status.</p>	Not met	<p>PMO officials stated that while the program reviews the schedule on a weekly basis and assesses risks to the program, it has not performed a schedule risk analysis. Best practices suggest that a schedule risk analysis can be used to determine a level of confidence in meeting the completion date or to determine whether proper reserves have been incorporated into the schedule. Such an analysis will calculate schedule reserve, which can be set aside for those activities identified as high risk. Without this reserve, the program faces the risk of delays to the scheduled completion date if any delays were to occur on critical path activities.</p>

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Best practice	Explanation	Criterion met	GAO analysis
9. Updating the schedule using logic and durations to determine the dates	The schedule should be continuously updated using logic and durations to determine realistic start and completion dates for program activities. The schedule should be analyzed continuously for variances to determine when forecasted completion dates differ from planned dates. This analysis is especially important for those variations that impact activities identified as being in a project's critical path and can impact a scheduled completion date.	Partially	<p>The status date for the version of the schedule we analyzed is January 1, 2010, a federal holiday. A status date denotes the date of the latest update to the schedule and thus defines the point in time at which completed work and remaining work are calculated. The PMO could not confirm that this date was correct. Assuming the status date is correct, we found several date anomalies within the schedule, suggesting that management may need to review how and when the schedule is updated. For example, we found 14 activities (less than 1 percent) that should have started but have no actual start date; 17 activities (less than 1 percent) that should have finished but have no actual finish date; and 155 activities (3 percent) that occurred in the past according to the schedule but are missing both actual start dates and actual finish dates.</p> <p>In addition, we found 22 (less than 1 percent) instances of out-of-sequence logic—that is, actual progress being recorded on activities that, according to schedule logic, should not have begun yet. This is a common occurrence in scheduling, as actual events often override planned logic. However, schedule logic should be updated to reflect changes as much as possible.</p>

Source: GAO analysis based on data provided by the ECSS PMO.

Table 14: Analysis of the Army's GFEBs Program Schedule

Best practice	Explanation	Initial result	Final result	GAO analysis
1. Capturing all activities	The schedule should reflect all activities as defined in the project's work breakdown structure, which defines in detail the work necessary to accomplish a project's objectives, including activities to be performed by both the owner and contractors.	Substantially	Substantially	<p>Initial Analysis: Our analysis found that while the Wave 4 deployment schedule captures both contractor and government activities, the program schedule is not fully integrated because individual deployment schedules for software releases are not related to activities within other program schedules. PMO officials stated that the while release and maintenance activities are integrated together in one schedule, and each deployment wave has its own schedule, the schedules are not linked to each other because the activities within each schedule are not related. However, a fully integrated master schedule would link government and contractor development, deployment, and subsequent maintenance activities.</p> <p>Activities in the program schedule are mapped to the program's integrated master plan, and deliverables in the Wave 4 schedule are mapped to the program's Quality Assurance Surveillance Plan through unique identification numbers. A large portion of the Wave 4 deployment schedule is made up of receiver milestones; that is, products the program needs to receive from external field sites before certain activities can be conducted. In addition to including government and contractor activities, the schedule also include tasks representing work being performed by external organizations.</p> <p>Updated analysis: No change to initial assessment.</p>
2. Sequencing all activities	The schedule should be planned so that critical project dates can be met. To meet this objective, activities need to be logically sequenced—that is, listed in the order in which they are to be carried out. In particular, activities that must be completed before other activities can begin (predecessor activities), as well as activities that cannot begin until other activities are completed (successor activities), should be identified. This helps ensure that interdependencies among activities that collectively lead to the accomplishment of events or milestones can be established and used as a basis for guiding work and	Minimally	Partially	<p>Initial analysis: Our analysis found 18 activities of 2,150 remaining (less than 1 percent) within the schedule that have no successor links, and three activities (less than 1 percent) that have neither successor nor predecessor links. Activities without successor links do not affect any other future activity. That is, they can continue until the end of the project without affecting the finish date of the project.</p> <p>The schedule includes 24 (1 percent) Must Start On (MSO) constraints. An MSO constraint is considered a "hard" date constraint because it prevents the activity from starting earlier or later than its planned date. This renders the schedule rigid and prevents the schedule from being dynamic. An MSO constraint is artificial and makes the scheduled activity appear to be on track to finish on time when it may not be. PMO schedulers told us that of the 24 MSO-constrained tasks, 15 (less than 1 percent of all remaining) are associated with executive briefings that are now out of scope and should be removed from the schedule. Of the remaining 9 MSO-constrained tasks, 8 are used to force successor activities to start on exactly the first days of calendar months. While these constraints may</p>

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Best practice	Explanation	Initial result	Final result	GAO analysis
	measuring progress.			<p>make scheduling activities simpler, they have an adverse effect on the project's critical path. An activity with an MSO constraint automatically becomes critical within scheduling software regardless of whether it actually should be critical. A final MSO constraint is attached to the "Go Live" milestone, which prevents the project finish milestone from shifting because of completed or remaining effort on predecessor activities. PMO officials acknowledged that the MSO constraint should not have been applied to the finish milestone and stated that it would be removed in the next update of the schedule.</p> <p>Our analysis also found that 50 summary tasks (12 percent of remaining summary tasks) have predecessor links. PMO schedulers told us that these summary links are used in lieu of linking predecessors to the numerous lower-level tasks. Because many of the lower-level tasks begin on the same date, this makes updating the schedule simpler: an updated start date for the summary task will force that same date on all the unlinked lower-level tasks. While this indeed makes updating easier, this technique is not considered a best practice. First, summary tasks do not represent work and are simply used as grouping elements. As such, they should take their start and finish dates from lower-level activities; they should not dictate the start or finish of lower-level activities. Secondly, linking summary tasks obfuscates the logic of the schedule. That is, tracing logic through summary links does not impart to management the sequence in which lower-level activities should be carried out.</p> <p>Our analysis found that 358 activities (17 percent) are scheduled to occur on a Sunday. This is a consequence of a summary task linked to a constrained milestone—constrained to start on the first day of a calendar month, which happened to be a Sunday and in turn causes a multitude of lower-level activities to also begin on a Sunday. PMO schedulers acknowledged that this was an error and the activities would be shifted to begin on a work day.</p> <p>There are 67 remaining activities (3 percent) that are linked to their successor activities with lags and 38 (2 percent) are linked with negative lags (or "leads"). Lags represent the passing of time between activities but are often misused to put activities on a specific date or to insert a buffer for risk. Lags should be justified because they cannot have risk or uncertainty. Without logically sequenced activities, the schedule cannot be used as a reliable basis for guiding work and measuring progress.</p> <p>Updated analysis: There are still 18 tasks within the schedule without successors (or less than 1 percent of</p>

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Best practice	Explanation	Initial result	Final result	GAO analysis
				<p>remaining activities in the updated schedule). While these activities have finish dates in December 2009 and February 2010, they do not have actual finish dates and we therefore cannot determine if these activities are completed or have the potential to cause future activities to slip. The updated schedule now contains 7 MSO constraints (less than 1 percent): the 15 constraints associated with executive meetings have been removed; the MSO constraint on the "Go Live" milestone has been removed; 2 MSO constraints marking the beginning of months have occurred; and 1 new constraint has been added to mark the beginning of the month following deployment. The 358 activities unintentionally scheduled to begin on a Sunday have been altered by a 1-day lag to begin on a proper workday. However, lags should not be used in lieu of logic to force activities to start on a specified date. Additionally, the updated schedule corrects minor missing predecessor logic issues.</p>
3. Assigning resources to all activities	<p>The schedule should reflect what resources (e.g., labor, materials, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist.</p>	Not met	Not met	<p>Initial analysis: GFEBs officials stated that because of the current FFP contractual arrangement, the government does not have insight into the contractor's efforts to assign resources to activities. They stated that while they are aware that activities in previous schedule releases were assigned resources by the contractor, the current schedule is not resource loaded. Resource information would assist the program office in forecasting the likelihood of activities being completed based on their projected end dates. If the current schedule does not allow for insight into current or projected over-allocation of resources, then the risk of the program slipping is significantly increased.</p> <p>Updated analysis: No change to initial assessment.</p>
4. Establishing the duration of all activities	<p>The schedule should realistically reflect how long each activity will take to execute. In determining the duration of each activity, the same rationale, historical data, and assumptions used for cost estimating should be used. Durations should be as short as possible and have specific start and end dates. The schedule should be continually monitored to determine when forecasted completion dates differ from planned dates; this information can be used to determine whether schedule variances will affect</p>	Fully met	Fully met	<p>Initial analysis: Seventy-two percent of remaining activities meet best practices for duration, being less than 44 days (or 2 working months). Activities with excessive durations (more than 100 days) represent effort being performed by organizations outside of the program office. Representing effort in the schedule that is performed by outside organizations is considered a best practice because it keeps management informed of ongoing work that might easily be forgotten until the deliverable is due, and the impact on future activities if the deliverable is behind schedule.</p> <p>Updated analysis: No change to initial assessment.</p>

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Best practice	Explanation	Initial result	Final result	GAO analysis
	subsequent work.			
5. Integrating schedule activities horizontally and vertically	The schedule should be horizontally integrated, meaning that it should link products and outcomes associated with other sequenced activities. These links are commonly referred to as “handoffs” and serve to verify that activities are arranged in the right order to achieve aggregated products or outcomes. The schedule should also be vertically integrated, meaning that the dates for starting and completing activities in the integrated master schedule should be aligned with the dates for supporting tasks and subtasks. Such mapping or alignment among levels enables different groups to work to the same master schedule.	Minimally	Minimally	<p>Initial analysis: The GFEBs program schedule includes detailed information on release, deployment, and maintenance government and contractor activities. However, our analysis of the schedule concludes that vertical integration—that is, the ability to consistently trace work breakdown structure elements between detailed, intermediate, and master schedules—is not fully demonstrated because none of the activities within the deployment schedules are related to activities associated with release, maintenance, or other wave schedules. PMO officials stated that while the release and maintenance activities are integrated together in one schedule, and each deployment wave has its own schedule, the schedules are not linked to each other because the activities within each schedule are not related. However, it is unlikely that deployment activities are unrelated to release or maintenance activities. Without vertically integrating the schedules, lower-level schedules cannot be clearly traced to upper-tiered milestones.</p> <p>Issues with reliance on hard date constraints, lags, and instances of convoluted logic such as linked summary tasks, keep the schedule from fully complying with the requirement of horizontal integration—that is, the overall ability of the schedule to clearly depict relationships between different program elements and product handoffs. Horizontal integration demonstrates that the overall schedule is rational, planned in a logical sequence, accounts for interdependencies between work and planning packages, and provides a way to evaluate current status.</p> <p>Updated analysis: No change to initial assessment.</p>
6. Establishing the critical path for all activities	Scheduling software should be used to identify the critical path, which represents the chain of dependent activities with the longest total duration. Establishing a project's critical path is necessary to examine the effects of any activity slipping along this path. Potential problems along or near the critical path should also be identified and reflected in scheduling the duration of high-risk activities.	Minimally	Partially	<p>Initial analysis: Our analysis could not determine a valid critical path—the longest duration path through the sequenced list of activities—because the “Go Live” finish milestone is constrained with an MSO constraint. An MSO constraint is considered a “hard” date constraint because it prevents the activity from starting earlier or later than its planned date. This renders the schedule rigid and prevents the schedule from being dynamic. An MSO constraint is artificial and makes the scheduled activity appear to be on track to finish on time when it may not be. When the constraint is removed, the “Go Live” milestone slips two months from its constrained date of January 3, 2011 to March 7, 2011.</p> <p>In addition, our analysis found that without the MSO constraint, the nearest driving activity to the “Go Live” milestone (that is, the activity determining the date of</p>

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Best practice	Explanation	Initial result	Final result	GAO analysis
				<p>the "Go Live" activity) is in October 2010. In other words, according to the schedule, no activity starting in November or December 2010 is critical to determining the "Go Live" date. Without clear insight into a critical path at the project level, management will not be able to monitor critical or near-critical detail activities that may have a detrimental impact on downstream activities if delayed.</p> <p>Updated analysis: The updated schedule has altered the predecessors on the "Go Live" finish milestone and the MSO constraint has been removed. The "Go Live" date is now scheduled to occur in February 2011. However, the critical path, as measured by the path with the lowest available float, shows only five activities from the "Go Live" date in February 2011 to the "Site Visit Activities Complete" milestone completed in March 2010. Because so few activities are on the current critical path, no activities scheduled within 1 or 2 months of deployment are currently driving the project finish date. In addition, the earliest critical activity on the path appears to be a functional survey scheduled for April 1, 2010, that has yet to actually start.</p>
7. Identifying reasonable float	The schedule should identify the float—the amount of time by which a predecessor activity can slip before the delay affects successor activities—so that a schedule's flexibility can be determined. As a general rule, activities along the critical path have the least float. Total float is the total amount of time by which an activity can be delayed without delaying the project's completion, if everything else goes according to plan.	Minimally	Minimally	<p>Initial analysis: We found that the Wave 4 Deployment schedule displays unrealistic total float values. For example, 1,273 activities (59 percent) within the schedule are showing negative float. That is, these activities are one to 242 days behind schedule. Other tasks display an unrealistic amount of positive float: 49 tasks (59 percent) are showing 100 to more than 300 days of total float. In other words, according to the schedule, 49 remaining activities could be delayed by more than 4 working months and not delay the final activity in the Wave 4 schedule. As a general rule, activities along the critical path have the least amount of float. Activities with large float values may indicate some lack of completeness in the schedule logic. Incorrect float estimates will result in an invalid critical path and an inability to allocate resources from noncritical activities to activities that cannot slip without affecting the project finish date.</p> <p>Updated analysis: The updated schedule continues to reflect unrealistic float. For example, 172 remaining activities (8 percent) have from 90 to 252 days of negative float, while 25 remaining activities (1 percent) have 104 to 310 days of float.</p>
8. Conducting a schedule risk analysis	A schedule risk analysis should be performed using statistical techniques to predict the level of confidence in meeting a project's completion date. This analysis focuses not only on	Not met	Not met	<p>Initial analysis: The PMO has not performed a schedule risk analysis. GFEBS officials stated that while schedule risks have been discussed in team meetings, the PMO has not performed a formal schedule risk analysis. However, officials stated that they are open to improving in the area of schedule risk analysis. Best practices suggest that a schedule risk</p>

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Best practice	Explanation	Initial result	Final result	GAO analysis
	critical path activities but also on activities near the critical path, since they can affect the project's status.			analysis can be used to determine a level of confidence in meeting the completion date or to determine whether proper reserves have been incorporated into the schedule. Such an analysis will calculate schedule reserve, which can be set aside for those activities identified as high-risk. Without this reserve, the program faces the risk of delays to the scheduled completion date if any delays were to occur on critical path activities. Updated analysis: No change to initial assessment.
9. Updating the schedule using logic and durations to determine the dates	The schedule should be continuously updated using logic and durations to determine realistic start and completion dates for program activities. The schedule should be analyzed continuously for variances to determine when forecasted completion dates differ from planned dates. This analysis is especially important for those variations that impact activities identified as being in a project's critical path and can impact a scheduled completion date.	Minimally	Partially	Initial analysis: The status date for the version of the Wave 4 schedule we analyzed is May 3, 2010. A status date denotes the date of the latest update to the schedule and thus defines the point in time at which completed work and remaining work are calculated. As of this date, we found a relatively large number of date anomalies within the schedule, suggesting that management may need to review how and when the schedule is updated. For example, we found 247 activities (11 percent) that should have started but have no actual start date and 200 activities (9 percent) that should have finished but have no actual finish date. Moreover, we found 7 activities (less than 1 percent) that have actual finish dates in the future. Schedule logic should be updated to reflect actual progress so that management is aware of the latest plan and the impacts to the project if activity planned dates are not met. Updated analysis: The updated schedule no longer includes activities that have actual finish dates beyond the status date. However, the schedule contains 44 activities (2 percent) that should have started but have no actual start date; 22 activities (1 percent) that should have finished but have no actual finish date; and 109 activities (5 percent) that should have started and finished but have neither an actual start nor actual finish date.

Source: GAO analysis based on data provided by the GFEBs PMO.

Note: The initial analysis reflects our assessment of the schedule originally submitted by the GFEBs PMO for our review. In response to limitations that we identified and shared with the GFEBs PMO, the program office enacted several formal changes to their existing schedule. The updated analysis reflects our review of the revised schedule.

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Table 15: Analysis of the Army's GCSS-Army Program Schedule

Best practice	Explanation	Criterion met	GAO analysis
1. Capturing all activities	The schedule should reflect all activities as defined in the project's work breakdown structure, which defines in detail the work necessary to accomplish a project's objectives, including activities to be performed by both the owner and contractors.	Partially	<p>We found that the GCSS-Army program schedule is not fully integrated. While the program schedule contains detailed contractor activities, it only contains some major government milestones. Other government activities, such as testing events and future milestones beyond December 2010, are displayed in isolated, high-level illustrated documents rather than in dynamic scheduling documents.</p> <p>We also found that contractor activities within the program schedule are assigned contractor work package numbers and can be traced to individual control account plans and contractor work breakdown structure elements. Activities are also assigned integrated product teams and individual control account managers.</p> <p>However, without fully integrating government activities with contractor activities, DOD cannot guarantee the schedule has either adequately captured all key activities necessary for the program's completion or that it can reliably estimate the finish date for the program.</p>

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Best practice	Explanation	Criterion met	GAO analysis
2. Sequencing all activities	The schedule should be planned so that critical project dates can be met. To meet this objective, activities need to be logically sequenced—that is, listed in the order in which they are to be carried out. In particular, activities that must be completed before other activities can begin (predecessor activities), as well as activities that cannot begin until other activities are completed (successor activities), should be identified. This helps ensure that interdependencies among activities that collectively lead to the accomplishment of events or milestones can be established and used as a basis for guiding work and measuring progress.	Partially	<p>We found that only 2 of 2,255 activities (less than 1 percent) are missing dependencies and 19 activities (less than 1 percent) have “dangling” logic—that is, activities whose start or finish dates are missing logic. These activities with dangling logic have no successor from their finish date, meaning they can carry on indefinitely without affecting the start date of any other activity. While dependencies within the schedule are generally sound, 60 percent of the activities (1,360) have Start No Earlier Than constraints. Start No Earlier Than constraints are considered “soft” date constraints because they allow an activity to slip into the future if their predecessor activity is delayed, but the activity cannot begin earlier than its constraint date. Program officials stated that Start No Earlier Than constraints are used to manually allocate resources and to coordinate data tests, which rely on coordination with outside partners. Officials further stated that individual control account managers monitor these constraints. However, we found that 87 percent of the constraints were actively affecting the start date of their activities. That is, without the constraint, the activity may be able to start sooner. If these activities cannot start earlier, then their dates and dependencies should be updated to reflect reality. Constraining over half of all activities to start on or after specific dates defeats the purpose of a dynamic scheduling tool and greatly reduces to ability of the program to take advantage of possible time savings.</p> <p>We also found 143 Finish No Earlier Than constraints (6 percent). These are also considered “soft” date constraints because they prevent activities from finishing earlier than their constraint date. Program officials stated that these were erroneously created in the schedule during an internal file conversion process and would be removed in the next version of the program schedule. Without logically sequenced activities, the schedule cannot be used as a reliable basis for guiding work and measuring progress.</p>
3. Assigning resources to all activities	The schedule should reflect what resources (e.g., labor, materials, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist.	Substantially	While the integrated master schedule is not resource loaded, scheduled activities can be traced to control account plans which have resources laid out by month by labor category. Budgets are assigned at the control account level and resources are accounted for in monthly updates to the program’s earned value management system.

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Best practice	Explanation	Criterion met	GAO analysis
4. Establishing the duration of all activities	The schedule should realistically reflect how long each activity will take to execute. In determining the duration of each activity, the same rationale, historical data, and assumptions used for cost estimating should be used. Durations should be as short as possible and have specific start and end dates. The schedule should be continually monitored to determine when forecasted completion dates differ from planned dates; this information can be used to determine whether schedule variances will affect subsequent work.	Fully met	Ninety-eight percent of remaining activities meet the best practice for activity duration, being less than 44 days. Only two remaining activities have durations that exceed the best practice, extending beyond 80 days.
5. Integrating schedule activities horizontally and vertically	The schedule should be horizontally integrated, meaning that it should link products and outcomes associated with other sequenced activities. These links are commonly referred to as "handoffs" and serve to verify that activities are arranged in the right order to achieve aggregated products or outcomes. The schedule should also be vertically integrated, meaning that the dates for starting and completing activities in the integrated master schedule should be aligned with the dates for supporting tasks and subtasks. Such mapping or alignment among levels enables different groups to work to the same master schedule.	Partially	The schedule is vertically integrated, with low-level tasks and milestones being traceable to higher-level summary tasks. While the schedule has a relatively small number of missing dependencies and activities with dangling logic, the use of date constraints on more than 60 percent of remaining activities, prevent the schedule from being completely horizontally integrated. That is, the date constraints limit the overall ability of the schedule to depict dynamic relationships between different program elements and product handoffs. Horizontal integration demonstrates that the overall schedule is rational, planned in a logical sequence, accounts for interdependencies between work and planning packages, and provides a way to evaluate current status.

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Best practice	Explanation	Criterion met	GAO analysis
6. Establishing the critical path for all activities	Scheduling software should be used to identify the critical path, which represents the chain of dependent activities with the longest total duration. Establishing a project's critical path is necessary to examine the effects of any activity slipping along this path. Potential problems along or near the critical path should also be identified and reflected in scheduling the duration of high-risk activities.	Partially	<p>We found that a reliable and realistic critical path could not be determined within the program schedule, and program officials agreed with our assessment. Program officials stated that the schedule is constructed to increase the visibility of each software object's development, and as a consequence of this amount of detail, a critical path cannot be shown. The schedule displays the detailed development life cycle for hundreds of objects and depending on the order in which objects are completed, the dependencies between objects, and the constant reallocation of resources, a traditional critical path may be too volatile to be useful. However, officials stated that a higher-level summary type schedule, which would display a valid critical path, would not allow management the proper insight into the risks underlying the development of each object. In lieu of a traditional critical path, program management monitors object development weekly and program officials stated that they are fully aware of which activities are behind or ahead of schedule.</p> <p>It is commendable that the schedule includes the necessary amount of complexity and detail to track lower-level, high-risk development activities. However, our analysis found that a critical path could not be derived because of artificial date constraints rather than complex object development detail. Program officials stated that three major milestones are being tracked: Critical Design Review, DTOE 1.1, and Build/Design Phase Completion. We found that critical paths do not exist for any of these milestones because of artificial date constraints on activities unrelated to detailed object development. As a result, we cannot determine a critical path to any major milestone based on actual effort related to object development. In this respect, the schedule cannot reliably forecast completion dates for Critical Design Review, DTOE, Build/Design Completion, or, as a consequence, Milestone C.</p>
7. Identifying reasonable float	The schedule should identify the float—the amount of time by which a predecessor activity can slip before the delay affects successor activities—so that a schedule's flexibility can be determined. As a general rule, activities along the critical path have the least float. Total float is the total amount of time by which an activity can be delayed without delaying the project's completion, if everything else goes according to plan.	Substantially	The majority of remaining tasks in the GCSS-Army contractor schedule appear to have reasonable total float values, varying from 0 to 30 days. Program office officials stated that they believe the schedule portrays accurate float. However, our analysis found 338 (15 percent) remaining activities with over 100 days of total float. In other words, according to the schedule, 338 remaining activities could be delayed by 4 months and not delay the final project date. Activities with large float values may indicate a lack of completeness in the schedule logic.

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Best practice	Explanation	Criterion met	GAO analysis
8. Conducting a schedule risk analysis	A schedule risk analysis should be performed using statistical techniques to predict the level of confidence in meeting a project's completion date. This analysis focuses not only on critical path activities but also on activities near the critical path, since they can affect the project's status.	Minimally	Program office officials stated that a schedule risk analysis is not routinely performed, and that there is currently no requirement for the contractor to do so. While no detailed risk analysis has been performed on the schedule, the contractor recently conducted a high-level Monte Carlo risk analysis on two major milestones for an integrated master schedule management review meeting. This high-level risk analysis shows the probability of completing the key milestones on time and identifies mitigating actions to prevent delays. Program officials stated they are interested in periodic risk analysis and intend to include a schedule risk analysis requirement in the contract within the next few months. A schedule risk analysis can be used to determine a level of confidence in meeting the completion date or whether proper reserves have been incorporated into the schedule. Such an analysis will calculate schedule reserve, which can be set aside for those activities identified as high risk. Without this reserve, the program faces the risk of delays to the scheduled completion date if any delays were to occur on critical path activities.
9. Updating the schedule using logic and durations to determine the dates	The schedule should be continuously updated using logic and durations to determine realistic start and completion dates for program activities. The schedule should be analyzed continuously for variances to determine when forecasted completion dates differ from planned dates. This analysis is especially important for those variations that impact activities identified as being in a project's critical path and can impact a scheduled completion date.	Substantially	We found no instances of illogical dates, such as actual start or actual finish dates in the future. We found 112 instances (5 percent) of out-of-sequence logic; that is, actual progress recorded on activities that, according to schedule logic, should not have started yet. This is a common occurrence in scheduling, as actual events often override planned logic. However, a large number of out-of-sequence activities may indicate that the schedule is not being thoroughly updated to reflect reality on a periodic basis.

Source: GAO analysis based on data provided by the GCSS-Army PMO.

Appendix V: Assessments of Four DOD ERP Program Cost Estimates

This appendix provides the results of our analysis of the extent to which the processes and methodologies used to develop and maintain the four ERP cost estimates meet the characteristics of high-quality cost estimates.¹ The four characteristics of high-quality estimates are explained and mapped to the 12 steps of such estimates in table 16.

Table 16: The 12 Steps of High-Quality Cost Estimating, Mapped to the Steps of a High-Quality Cost Estimate

Characteristic	Explanation	Step
Well-documented	The documentation should address the purpose of the estimate, the program background and system description, its schedule, the scope of the estimate (in terms of time and what is and is not included), the ground rules and assumptions, all data sources, estimating methodology and rationale, the results of the risk analysis, and a conclusion about whether the cost estimate is reasonable. Therefore, a good cost estimate—while taking the form of a single number—is supported by detailed documentation that describes how it was derived and how the expected funding will be spent in order to achieve a given objective. For example, the documentation should capture in writing such things as the source data used and their significance, the calculations performed and their results, and the rationale for choosing a particular estimating method or reference. Moreover, this information should be captured in such a way that the data used to derive the estimate can be traced back to and verified against their sources, allowing for the estimate to be easily replicated and updated. Finally, the cost estimate should be reviewed and accepted by management to ensure that there is a high level of confidence in the estimating process and the estimate itself.	<p>Step 1: Define the estimate’s purpose, scope, and schedule</p> <p>Step 3: Define the program characteristics</p> <p>Step 5: Identify ground rules and assumptions</p> <p>Step 6: Obtain the data</p> <p>Step 10: Document the estimate</p> <p>Step 11: Present the estimate to management for approval</p>
Comprehensive	The cost estimates should include both government and contractor costs of the program over its full life cycle, from inception of the program through design, development, deployment, and operation and maintenance to retirement of the program. They should also completely define the program, reflect the current schedule, and be technically reasonable. Comprehensive cost estimates should provide a level of detail appropriate to ensure that cost elements are neither omitted nor double counted, and they should document all cost-influencing ground rules and assumptions. Establishing a product-oriented work breakdown structure (WBS) is a best practice because it allows a program to track cost and schedule by defined deliverables, such as a hardware or software component.	<p>Step 2: Develop the estimating plan</p> <p>Step 4: Determine the estimating structure</p> <p>Step 5: Identify ground rules and assumptions^a</p>

¹GAO-09-3SP.

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Program Cost Estimates**

Characteristic	Explanation	Step
Accurate	The cost estimates should provide for results that are unbiased, and they should not be overly conservative or optimistic. Estimates are accurate when they are based on an assessment of most likely costs, adjusted properly for inflation, and contain few, if any, minor mistakes. In addition, the estimates should be updated regularly to reflect material changes in the program, such as when schedules or other assumptions change, and actual costs so that the estimate is always reflecting current status. Among other things, the estimate should be grounded in documented assumptions and a historical record of cost estimating and actual experiences on other comparable programs.	Step 7: Develop the point estimate ^b Step 12: Update the estimate to reflect actual costs and changes
Credible	The cost estimates should discuss any limitations of the analysis because of uncertainty or biases surrounding data or assumptions. Major assumptions should be varied, and other outcomes recomputed to determine how sensitive they are to changes in the assumptions. Risk and uncertainty analysis should be performed to determine the level of risk associated with the estimate. Further, the estimate's results should be crosschecked, and an independent cost estimate conducted by a group outside the acquiring organization should be developed to determine whether other estimating methods produce similar results. For management to make good decisions, the program estimate must reflect the degree of uncertainty, so that a level of confidence can be given about the estimate. Having a range of costs around a point estimate is more useful to decision makers because it conveys the level of confidence in achieving the most likely cost and also informs them on cost, schedule, and technical risks.	Step 7: Compare the point estimate to an independent cost estimate ^c Step 8: Conduct sensitivity analysis Step 9: Conduct risk and uncertainty analysis

Source: GAO-09-3SP.

^aThis step applies to two of the characteristics—well-documented and comprehensive.

^bA point estimate is a single cost estimate number representing the most likely cost.

^cThis step applies to two of the characteristics—credible and accurate.

Tables 17, 18, 19, and 20 provide the detailed results of our analysis of the program cost estimates for DEAMS, ECSS, GFEBS and GCSS-Army. “Not met” means the program provided no evidence that satisfies any of the criterion. “Minimally” means the program provided evidence that satisfies a small portion of the criterion. “Partially” means the program provided evidence that satisfies about half of the criterion. “Substantially” means the program provided evidence that satisfies a large portion of the criterion. “Fully met” means the program provided evidence that completely satisfies the criterion.

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Program Cost Estimates**

Table 17: Analysis of the Air Force’s DEAMS Cost Estimate

Four characteristics of high-quality cost estimates	Criterion met	Key examples of rationale for assessment
Well-documented	Substantially	<p>The purpose, scope and schedule of the estimate were clearly defined. Further, the estimate identified all the ground rules and assumptions as well as the estimating methodology. The PMO presented evidence of receiving approval of the estimate through briefings to management. The sources of data the estimate was based on were also documented.</p> <p>However, we found inconsistencies when comparing the program requirements found in the Cost Analysis Requirements Document (CARD) with the requirements contained in the cost estimate. For example, commercial-off-the-shelf (COTS) software licenses requirements outlined in the CARD do not match the assumptions used in the cost estimate.</p>
Comprehensive	Fully met	<p>The program provided supporting documentation that showed the ground rules and assumptions. The estimate is based on a cost element structure as stated in the Department of Defense Automated Information System Economic Analysis Guide. The program also provided an estimating plan that included the cost estimating schedule.</p>
Accurate	Fully met	<p>The DEAMS cost model details the calculations and inflation indexes underlying the estimated costs. Calculations within the model can be traced back to supporting documentation. In addition, the cost model is updated annually to incorporate actual costs expended in prior fiscal years.</p>
Credible	Fully met	<p>An independent cost estimate was developed by the Air Force Cost Analysis Agency. The PMO and Air Force Cost Analysis Agency also conducted analyses to identify the cost elements with the greatest degree of uncertainty, and determine the cost drivers for the program, and performed analyses to determine the impact of changing major ground rules and assumptions. For example, during the reconciliation process, there was debate as to the best estimate for the total number of DEAMS users. The PMO performed a sensitivity analysis on this parameter to illustrate the total life cycle cost impact of changing this assumption.</p> <p>The PMO submitted several supporting documents that detail the risk and uncertainty analysis performed on the cost estimates. In addition to the risk and uncertainty analysis, the PMO implemented a risk management process at the inception of the program and is planned to continue throughout the program’s life.</p>

Source: GAO analysis based on data provided by the DEAMS PMO.

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Table 18: Analysis of the Air Force’s ECSS Cost Estimate

Four characteristics of high-quality cost estimates	Criterion met	Key examples of rationale for assessment
Well-documented	Substantially	The purpose, scope and schedule of the estimate were clearly defined. The PMO presented evidence of receiving approval of the estimate through briefings to management. The data sources were also documented. The PMO also provided ample descriptions of the methodology used to derive the estimates. However, our analysis found inconsistencies between requirements found in the CARD and assumptions used to calculate the estimate. For example, personnel requirements and the number of reports, interfaces, conversions, and extensions were different between the two documents.
Comprehensive	Fully met	The program provided supporting documentation that showed the ground rules and assumptions. The estimate is prepared in accordance with the Office of the Secretary of Defense ERP work breakdown structure as stated in draft DOD guidance. ^a The program also provided an estimating plan that included the cost estimating schedule.
Accurate	Substantially	<p>The ECSS cost model details the calculations and inflation indexes underlying the estimated costs. Calculations within the model can be traced back to supporting documentation. However, our analysis found minor inconsistencies when cross-checking costs that were presented to management and the underlying calculations within the model. For example, estimates for data migration, data cleansing, and help desk within the cost model do not match the cost estimates presented to management.</p> <p>ECSS PMO officials stated they cannot compare actual costs to the cost estimate because they do not yet have an approved baseline. However, these officials stated the program has a Baseline Change Board that holds monthly Resource Board meetings during which officials review the program baseline to assess the potential impacts of proposed changes to all aspects of the program’s life cycle.</p>
Credible	Partially	<p>An independent cost estimate was created by the Air Force Cost Analysis Agency. ECSS PMO officials stated that the cost estimate was adjusted based on sensitivity analyses. However, the cost estimate model does not include evidence of a sensitivity analysis. Because the Air Force did not conduct a sensitivity analysis to identify the effects of uncertainties associated with different assumptions, there is an increased risk that decisions will be made without a clear understanding of the possible impact on cost and benefit estimates.</p> <p>The ECSS PMO performed a cost risk and uncertainty analysis. This analysis shows that the service cost position is at the 60 percent confidence level—meaning there is a 40 percent chance of a cost overrun. In addition to the risk and uncertainty analysis, the PMO has implemented a risk management process to identify and mitigate schedule, cost, and performance risks.</p>

Source: GAO analysis based on data provided by the ECSS PMO.

^aMIL-HDBK-881.

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Program Cost Estimates**

Table 19: Analysis of the Army's GFEBS Cost Estimate

Four characteristics of high-quality cost estimates	Criterion met	Key examples of rationale for assessment
Well-documented	Fully met	The purpose, scope and schedule of the estimate were clearly defined. Further, the documentation identified all the ground rules and assumptions as well as the estimating methodology. The PMO presented evidence of receiving approval of the estimate through briefings to management. The sources of data the estimate was based on were also documented.
Comprehensive	Fully met	The program provided supporting documentation that showed the ground rules and assumptions underlying the cost estimate. The estimate is based on a cost estimating structure as dictated by the Department of the Army Economic Analysis Manual. The program also provided an estimating plan that included the cost estimating schedule.
Accurate	Substantially	The GFEBS cost estimate details the calculations and inflation indexes underlying the estimated costs. Calculations within the model can be traced back to supporting documentation. In addition, evidence was provided that shows how estimated costs were derived based on actual costs incurred to date. For example, the estimated cost for program management is based on actual historical program management costs. However, because a cost uncertainty analysis has not been performed, DOD cannot guarantee that the estimate represents most likely costs to be incurred.
Credible	Minimally	An independent cost estimate was created by the Office of the Deputy Assistant Secretary of the Army for Cost and Economics. However, the estimate does not include either a sensitivity or risk and uncertainty analysis. The GFEBS PMO stated that it has adequately accounted for risks in the cost estimate based on the maturity of the program and the reconciliation process between the PMO estimate and the independent cost estimate. However, because the Army did not conduct a sensitivity analysis to identify the effect of uncertainties associated with different assumptions, there is an increased risk that decisions will be made without a clear understanding of the possible impact on cost and benefit estimates.

Source: GAO analysis based on data provided by the GFEBS PMO.

Table 20: Analysis of the Army's GCSS-Army Cost Estimate

Four characteristics of high-quality cost estimates	Criterion met	Key examples of rationale for assessment
Well-documented	Substantially	The purpose, scope and schedule of the cost estimate were clearly defined. The program has a current technical baseline document, and the PMO presented evidence of receiving approval of the estimate through briefings to management. However, the Economic Analysis documentation describing the cost estimate presents costs at a high level but does not provide details on lower level cost elements.
Comprehensive	Substantially	<p>The GCSS-Army PMO uses a "hybrid" work breakdown structure for the program based on its collaboration with the Office of the Secretary of Defense Cost and Resource Center. This hybrid work breakdown structure while not entirely product-oriented, standardizes the vocabulary for cost elements for automated information systems. Because there is currently no standardized work breakdown structure in use by DOD that corresponds to the implementation of an ERP system, the PMO worked closely with the Office of the Secretary of Defense Cost and Resource Center to develop a mutually acceptable work breakdown structure that meets best practices.</p> <p>In addition, the program provided supporting documentation that showed the ground rules and assumptions used to generate the cost estimate. However, our analysis shows that not all ground rules and assumptions were used to develop the cost risk and uncertainty analysis. For example, there are several assumptions associated with the number of software licenses, yet the risk and uncertainty analysis does not reflect any risk associated with these assumptions.</p>
Accurate	Partially	The cost estimate model shows the methodology and calculations used to prepare the estimate. However, because the PMO did not provide supporting documentation that details the use of actual costs to derive cost estimates, we are unable to verify the quality of the cost estimates. Programs should be monitored continuously for their cost-effectiveness by comparing planned and actual performance against the approved program baseline. The estimates should be updated with actual costs so that it is always relevant and current. This results in a higher-quality cost estimate and provides an opportunity to incorporate lessons learned.

**Appendix V: Assessments of Four DOD ERP
Program Cost Estimates**

**Four characteristics of
high-quality cost
estimates**

Criterion met

Key examples of rationale for assessment

Credible

Partially

An independent cost estimate was created by the Army Cost Review Board Working Group. However, the cost estimate does not include a sensitivity analysis. Because the Army did not conduct a sensitivity analysis to identify the effects of uncertainties associated with different assumptions, there is an increased risk that decisions will be made without a clear understanding of the possible impact on cost and benefit estimates.

The supporting documentation shows risk-adjusted costs, which were generated by applying probability distributions to cost elements within the cost model. However, the probability distributions applied throughout the model to account for risks are generalized and do not make a distinction in how specific risks may affect specific cost elements differently.

While the GCSS-Army PMO has a risk process to identify, analyze, plan, track, control, and communicate risks, our analysis found that the PMO did not adequately link risks to the cost estimate. For example, data cleansing and data migration are noted as high-risks within the risk register but they are not accounted for in the risk and uncertainty analysis. Without a realistic risk and uncertainty analysis, the PMO can neither quantify the level of confidence in achieving a program within a certain funding level, nor determine a defensible amount of contingency reserve to quickly mitigate risk.

Source: GAO analysis based on data provided by the GCSS-Army PMO.

Note: The focus of our GCSS-Army cost assessment is the “ratified” GCSS-Army Cost Position dated November 2006 because the ratified Army Cost Position represents a more detailed approach to the program’s cost estimating process compared to the current “federated” approach estimate for Milestone B. The current federated estimate, which reflects the federated ERP integration strategy for GCSS-Army and General Funds Enterprise Business Systems (GFEBS), was developed within 40 days as mandated by the Department of the Army. The PMO plans to implement a more detailed cost estimating process for their federated Army Cost Position in preparation for Milestone C in February 2011.

Appendix VI: GAO Contacts and Staff Acknowledgments

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